NOVEMBER 1959

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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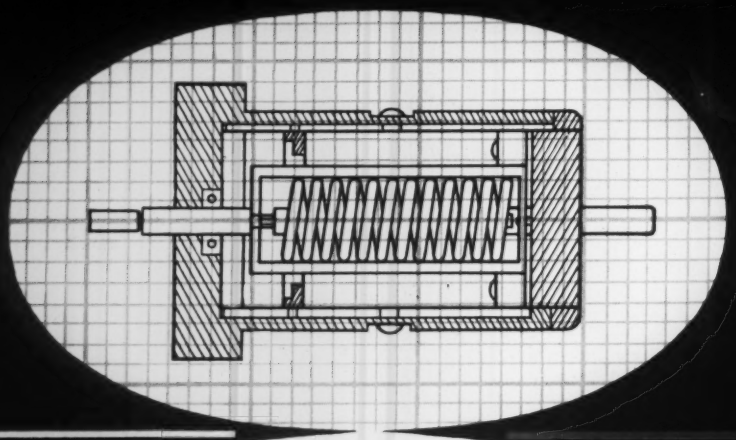

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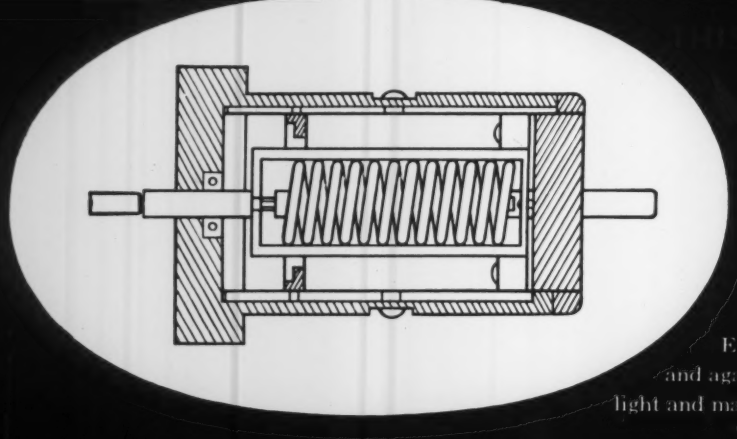

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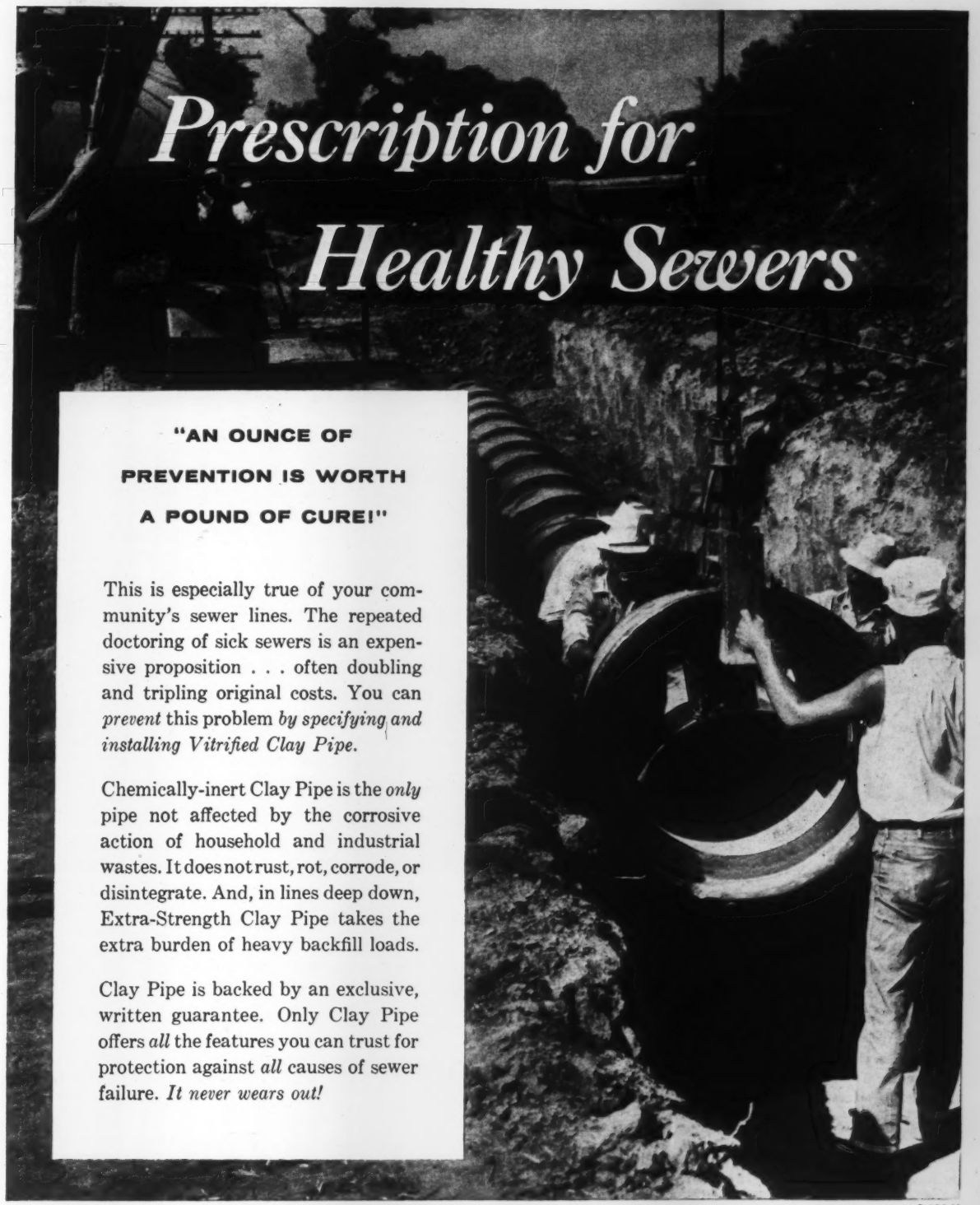
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CIVIL ENGINEERING

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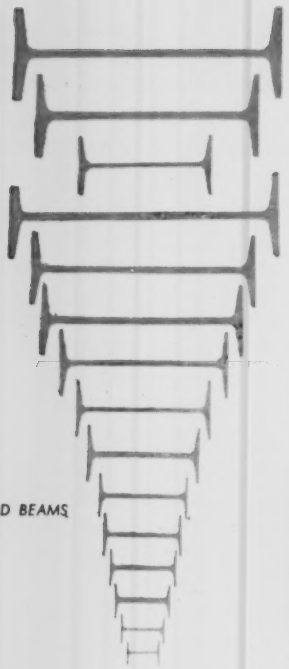

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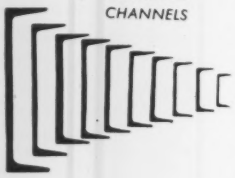

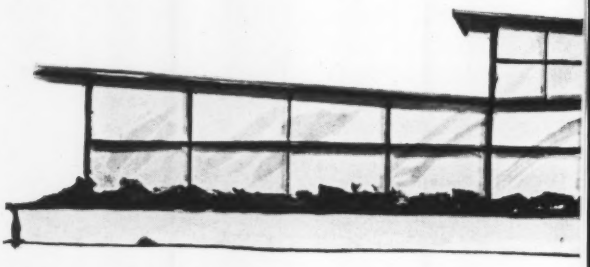

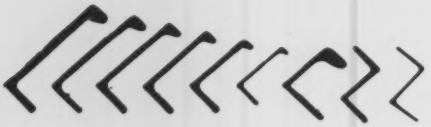

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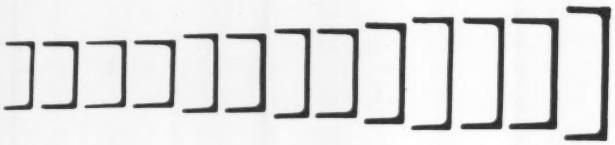

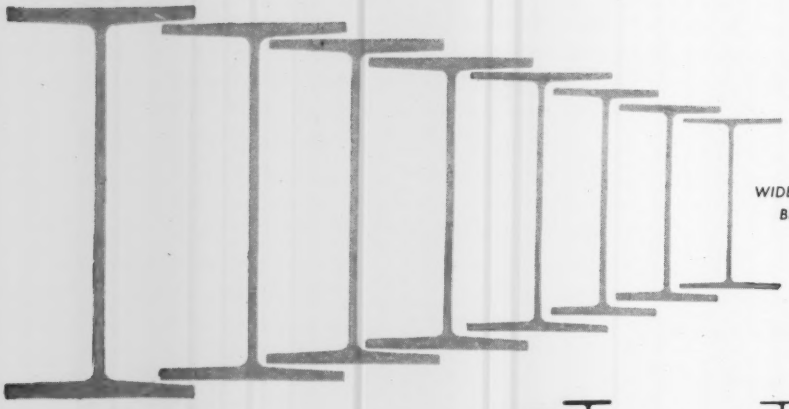

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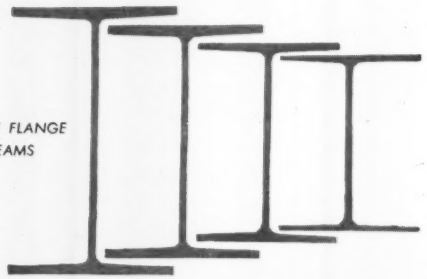

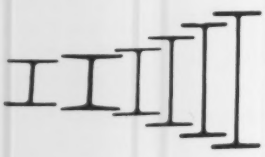

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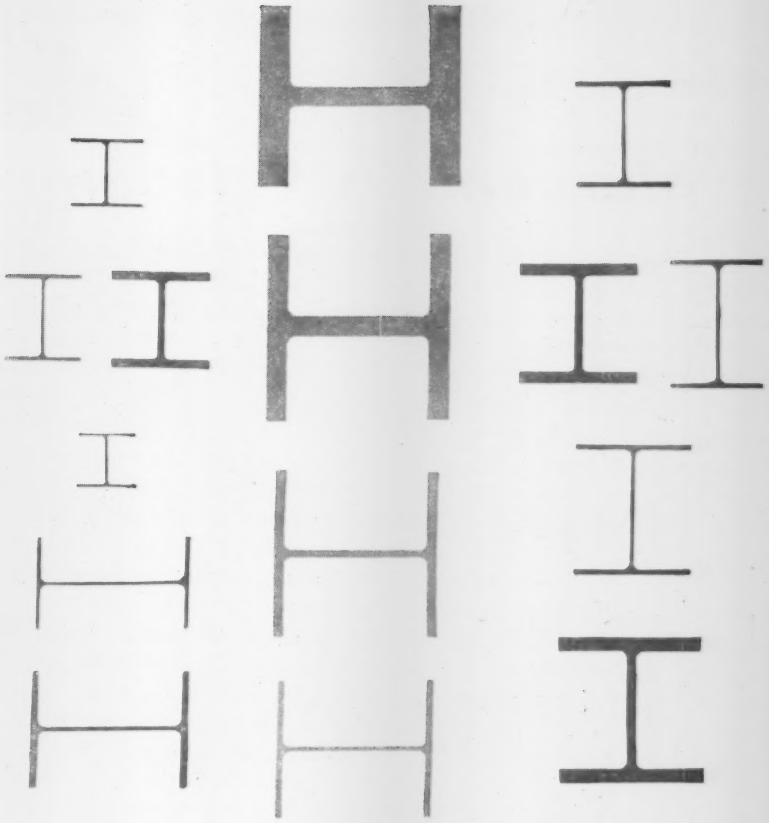

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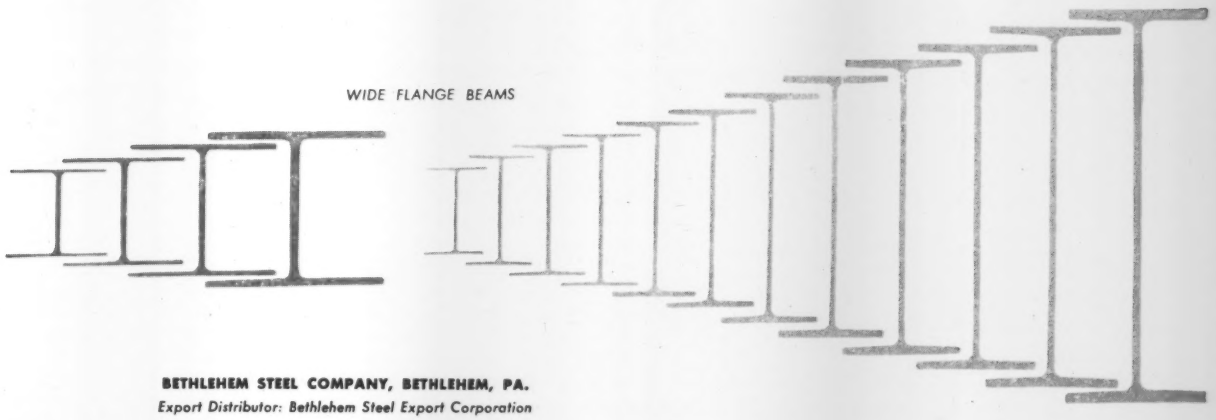

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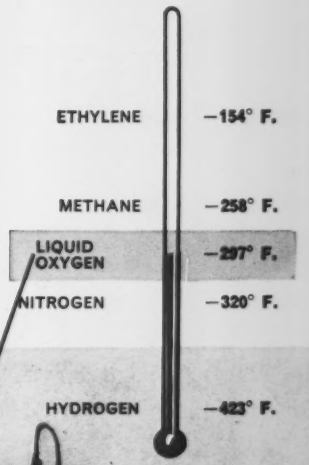

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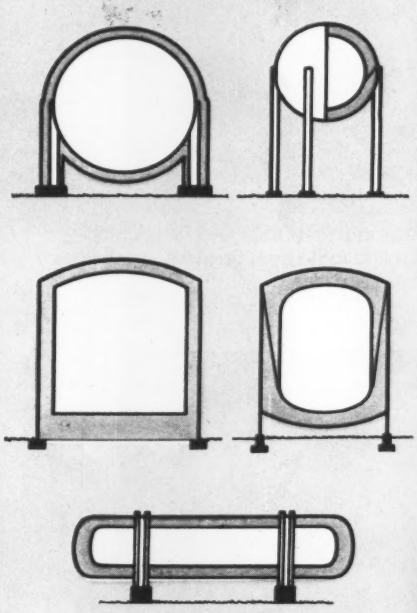

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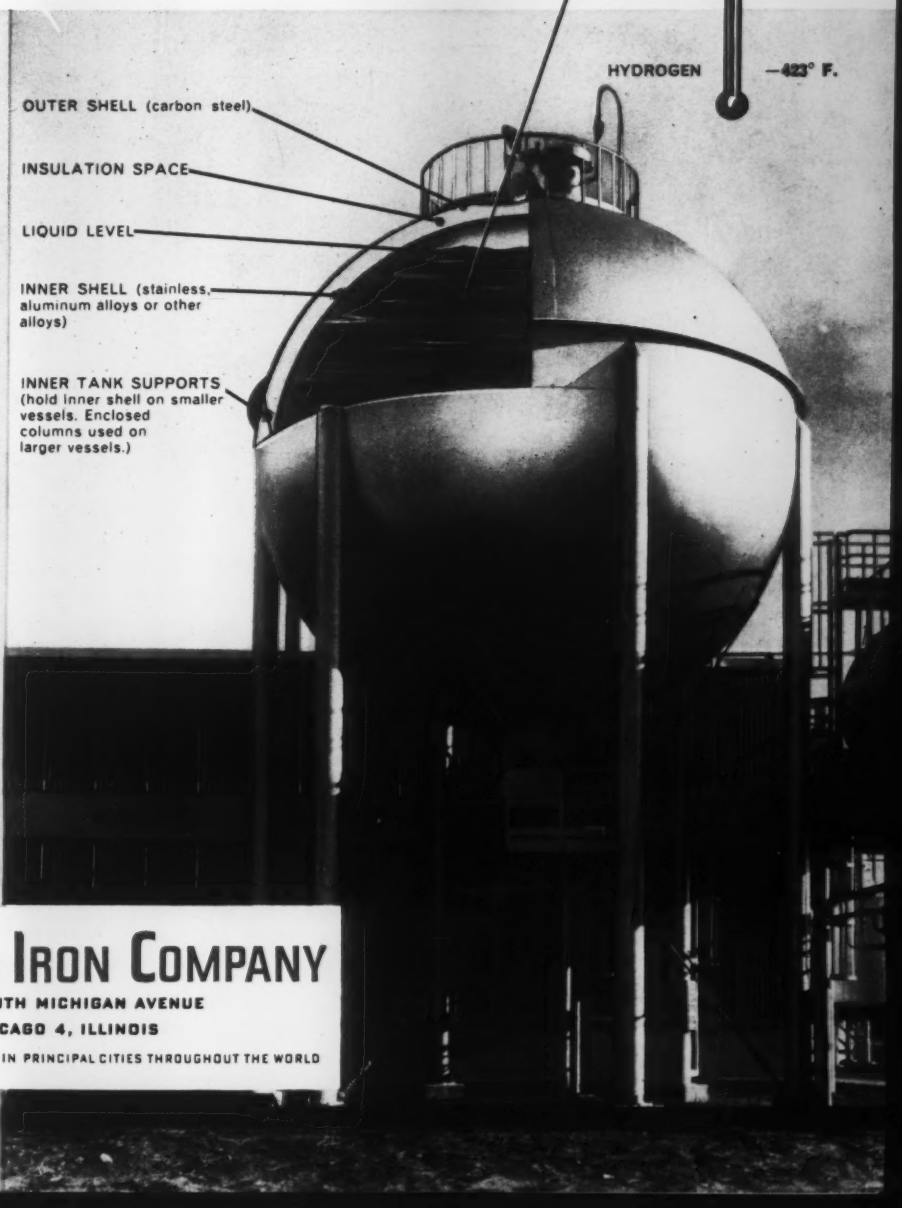
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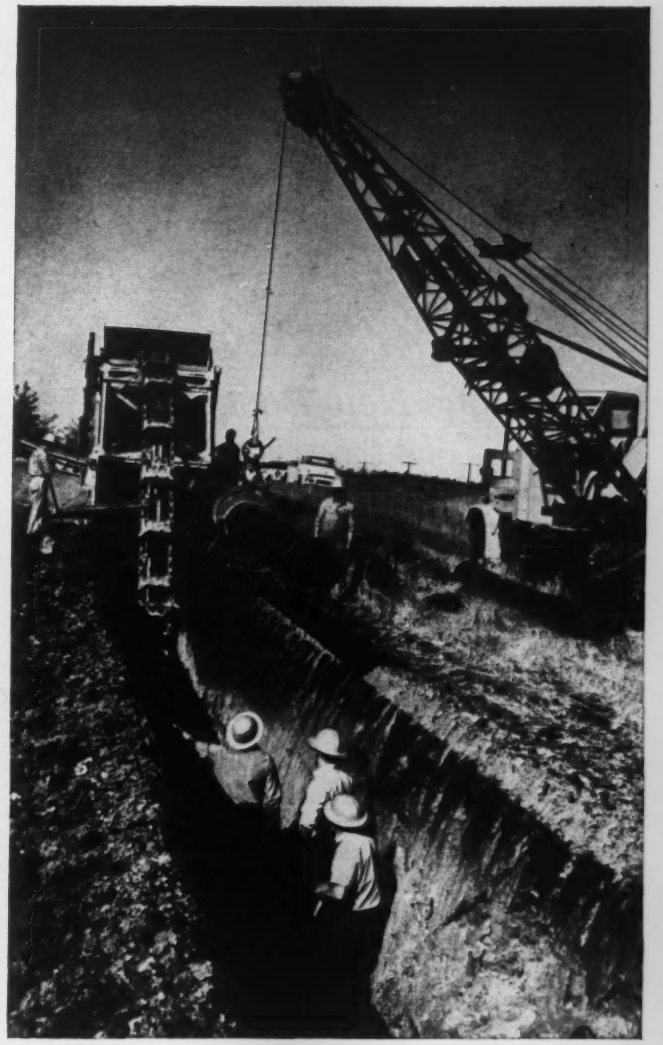

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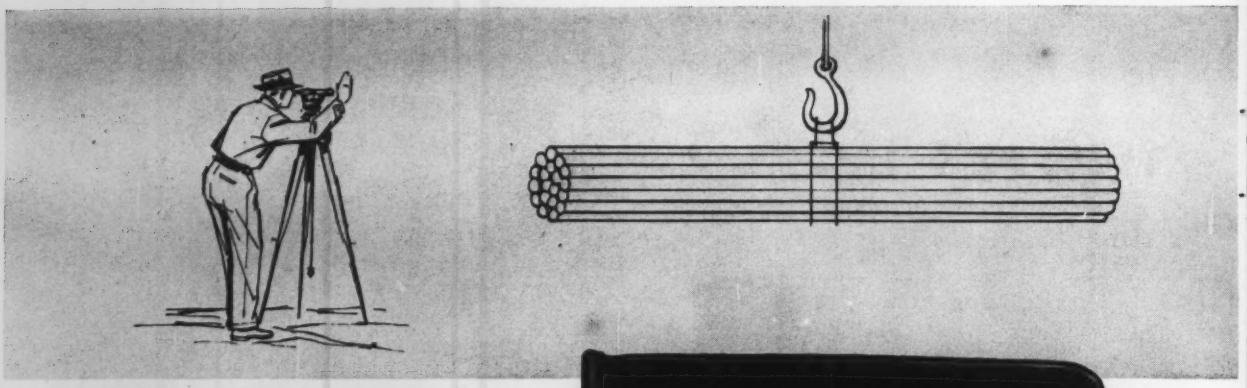

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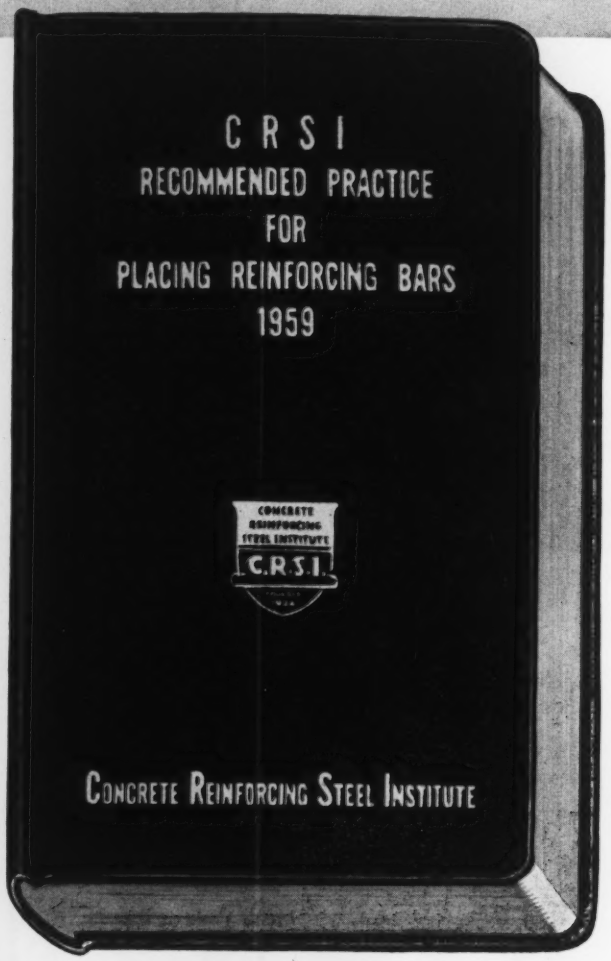

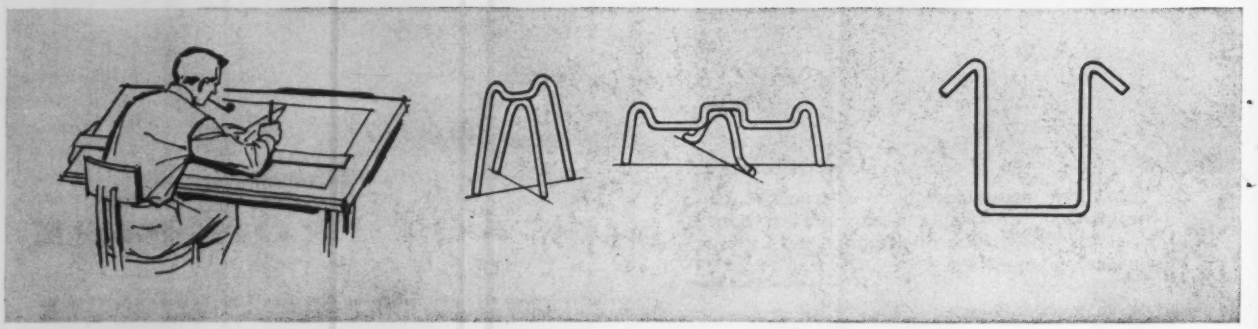

FOREWORD
This manual was originally written as a guide for reinforcing bar setters. It became apparent that the manual would serve a much more useful purpose if expanded to cover the field of interest of the detailer who prepares the plans used by the bar setter, also the engineer, architect, contractor, and, most important, the field inspector.
Increasing refinement of design methods and quality control of construction materials demands comparable improvement in construction practices. Without these improvements it would be very difficult, if not impossible, to utilize properly the progress being made in design concepts and materials.
Briefly, this manual summarizes the best of the accepted current practices in the placement of reinforcing bars, welded wire fabric, and their supports, in reinforced concrete structures. It will be a valuable aid to teachers and students of architecture and engineering, as it contains much information not usually found in textbooks.
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South Holly Filter Plant interior shows 9 Allis-Chalmers transfer pump station butterfly valves at the right, a wash water controller butterfly valve at left center, and 3 wash water butterfly valves at the lower left.

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71 ALLIS-CHALMERS VALVES

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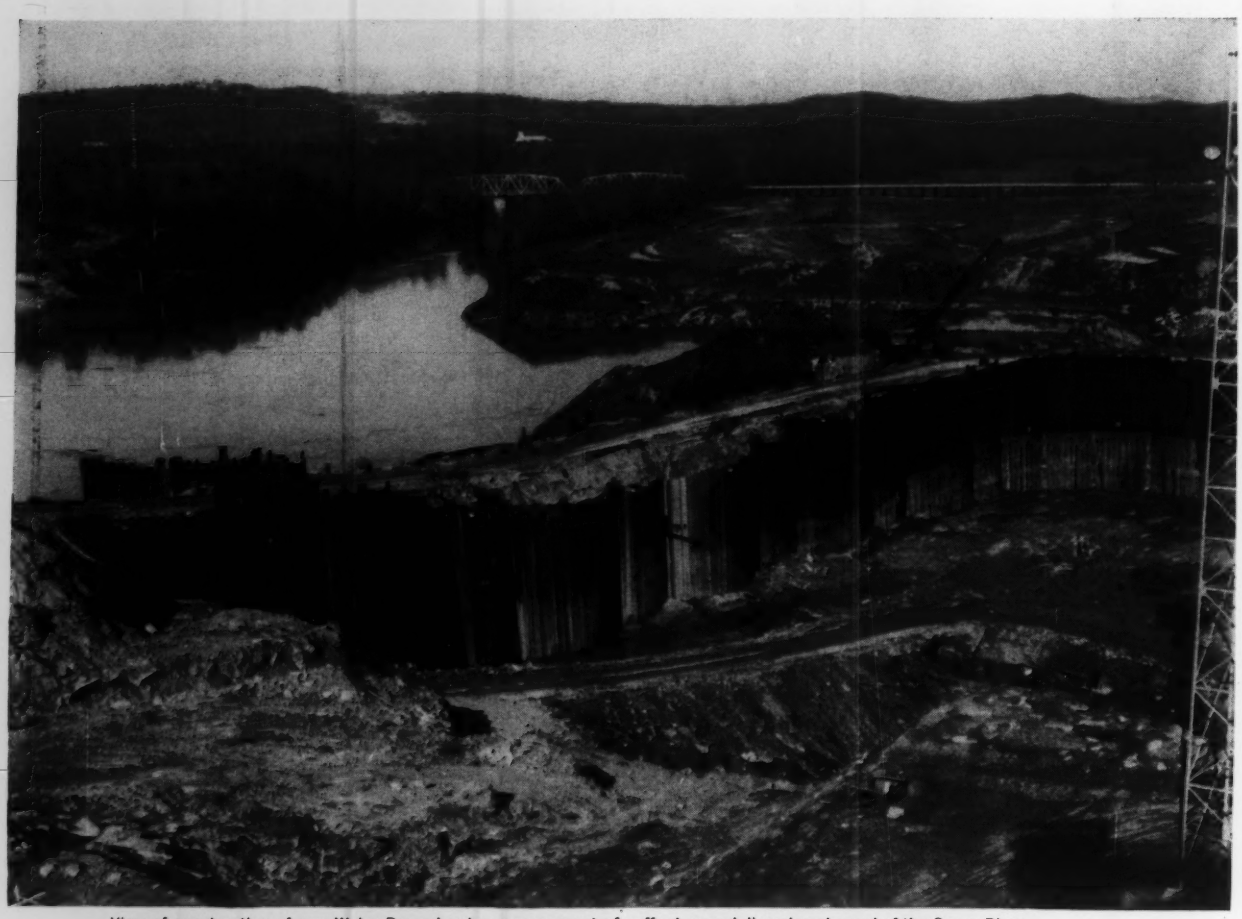

View of construction of new Weiss Dam showing arrangement of cofferdam and diversion channel of the Coosa River. Owner: Alabama Power Co. Project Superintendent: C. B. McCullar. Contractors: Morrison-Knudsen, Inc., Boise, Idaho and Moss-Thornton Company, Inc., Leeds, Alabama. Project Manager for Morrison-Knudsen: Mr. Harold Maxwell.

Alabama Power's new Weiss Dam starts with USS Sheet Steel Piling

The new Coosa River Development Program of the Alabama Power Company will include five dams and hydro-electric power plants between Rome, Georgia and Wetumpka, Alabama. The first of these is the Weiss Dam now under construction at Leesburg, Alabama. This $30 million project is scheduled for completion by mid-1961.

To get the work started, the contractor built a 19-cell cofferdam using 3,800 tons of USS MP-101 Sheet Steel Piling. This diverted the river and dried up the construction area. Each cell is 60.48 feet in diameter and about 60 feet high.

They drove the piling to solid rock through overburden 30 feet deep. Cells were filled with sand and gravel, which also provided a work road across the top of the cofferdam.

The diversion dam and power plant will require 143,000 cubic yards of concrete and 3,650 tons of reinforcing steel. The reservoir created by the dam will cover 45 square miles.

The excellent service rendered on this large cofferdam job is another example of the advantages offered by U.S. Steel's large production facilities and attention to customer's needs. When you want any type of piling—steel sheet piling or steel H-piles —call the U.S. Steel office near you. *USS is a registered trademark*

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SEVEN CONCRETE WAYS

HI-HED® PIPE

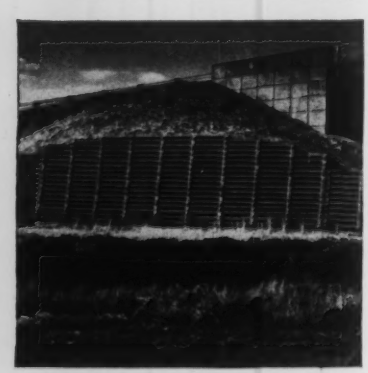
- 50% STRONGER—on the average than equivalent size round pipe
- SAVES TRENCH WIDTH—in congested areas
- GREATER CAPACITY — than any equivalent size round pipe

ROUND PIPE

- MINIMUM ENTRANCE LOSS—gives greater capacity, permits smaller diameters
- STRENGTHS PRETESTED—to eliminate guesswork
- SMOOTH INNER SURFACE—provides maximum round pipe hydraulic capacity

American-Marietta offers highway engineers and contractors a related group of seven concrete products—each precast for faster installation at less cost—each designed to do a specific job better.

Expanded manufacturing facilities are located strategically throughout the United States to assure distribution near points of use.



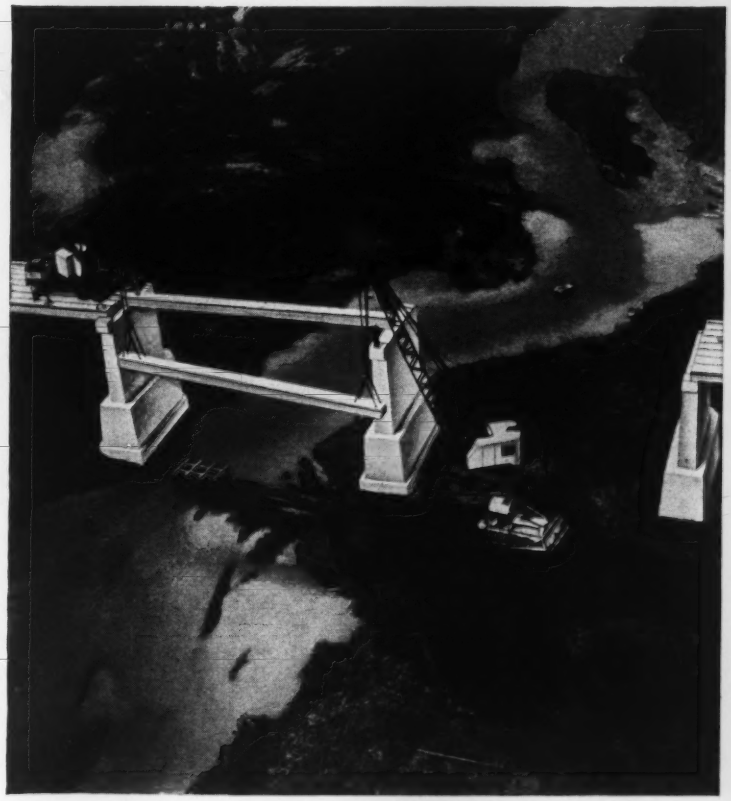
CRIBBING

- LONGEST LIFE—stays attractive without maintenance
- FLEXIBLE CONSTRUCTION—unaffected by movement
- EASY TO REMOVE—for relocation

LO-HED® PIPE

- GREATER CAPACITY—two Lo-Hed culverts carry more water than three round pipes of the same height
- MINIMUM DEPTH OF CUT—affords increased cushion of cover
- FASTER INSTALLATION—easier to lay, precasting eliminates bottlenecks

TO CUT HIGHWAY COSTS



BRIDGE BEAMS

- FASTER, EASIER ERECTION—with minimum traffic interruption
- MINIMUM DEPTH-TO-SPAN RATIO—for less weight, greater clearance and reduced fill
- ALL SPAN LENGTHS—precast beams to 35 feet, prestressed Amdek beams up to 100 feet and more
- MINIMUM MAINTENANCE—stays beautiful for years

INNER CIRCLES®

- MINIMUM SURFACE EXCAVATION—pipe passes through pipe *underground*
- OVERHEAD TRAFFIC UNDISTURBED—no weather problem, winter or summer
- LOW COST—no setting of forms or bracing of finished work

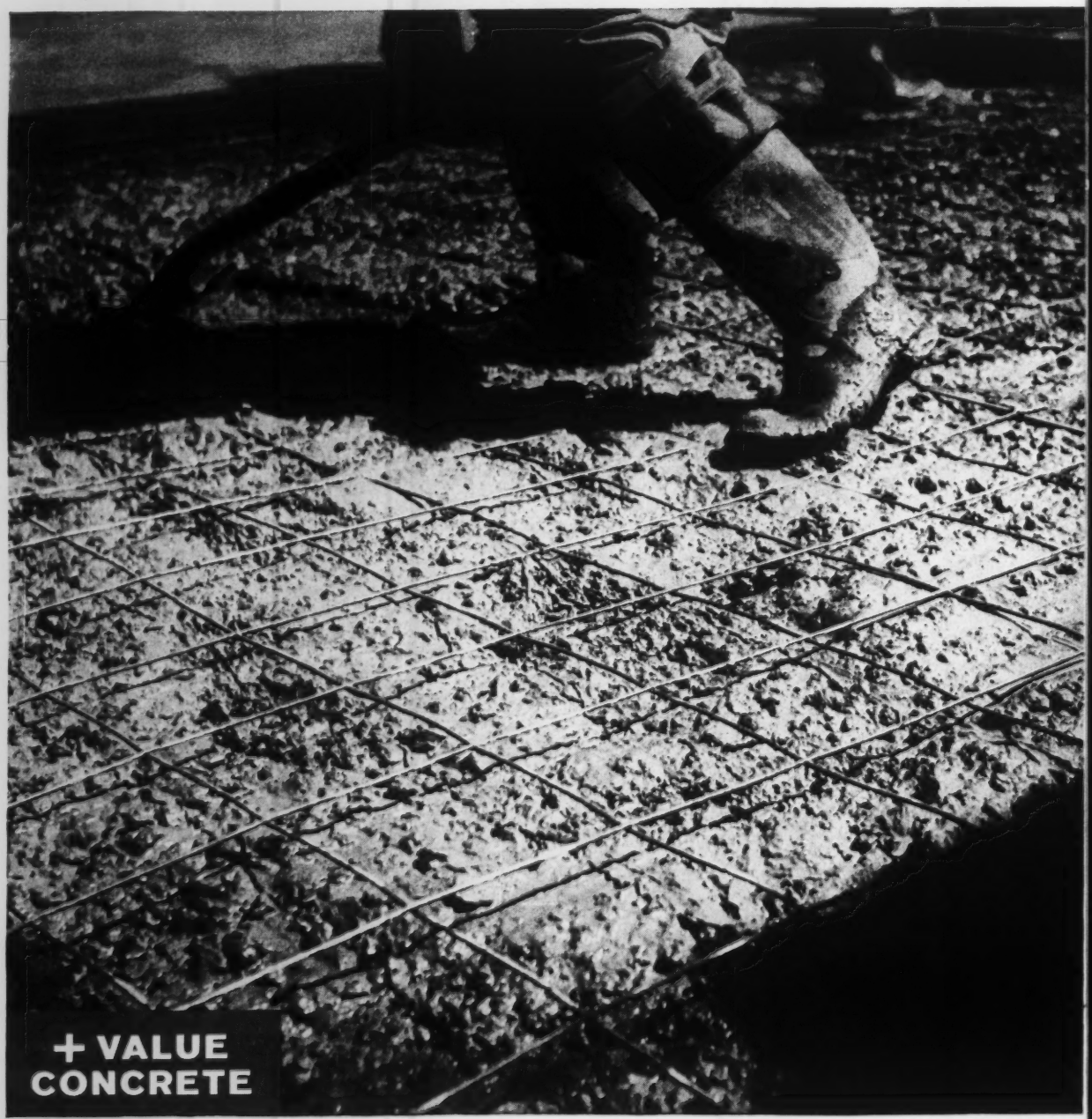
FLAT BASE

- VERSATILE—serves as pedestrian and cattle underpasses, culverts, utility galleries and manholes
- FAST—place and cover 100 feet or more per day. Easy to jack
- ECONOMICAL—saves up to 30% in construction costs

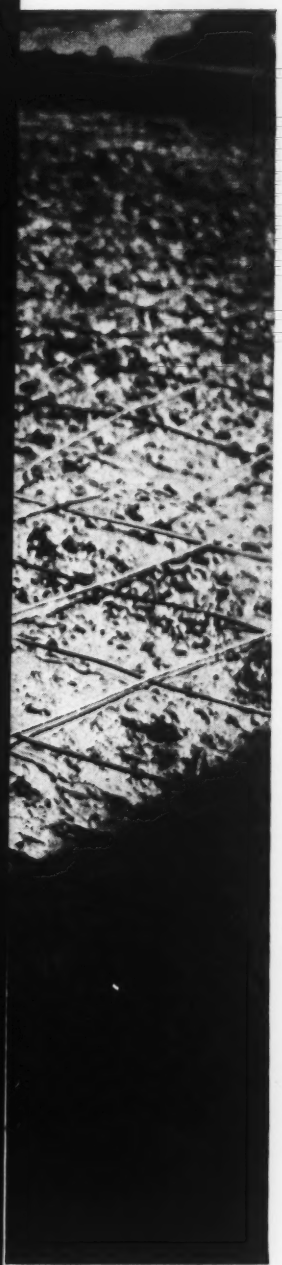
Write for the name of the American-Marietta concrete product plant nearest you. Also, ask for free illustrated literature on any of the products shown on these pages.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

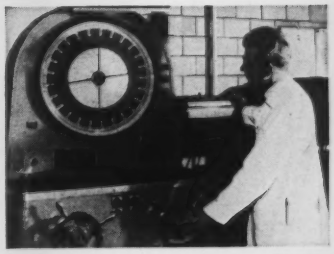
New, improved USS American Welded strength of 75,000 psi...and a



Wire Fabric has minimum tensile minimum yield point of 60,000 psi...



to give you a better, stronger product at no increase in cost!



For more than 50 years, USS American Welded Wire Fabric has been doing an outstanding job of reinforcing all kinds of concrete work—from porches and walks to skyscrapers and highways. And now—because of its greatly increased tensile and yield strength—it will give even greater strength, longer life, increased freedom from cracking and less maintenance. Also, it will permit longer joint spacing for reinforced slabs on ground or less steel if present joint spacing is used. The new improved Welded Wire fabric will have a 75,000 psi minimum ultimate tensile strength with a minimum yield point of 60,000 psi.

Closely controlled laboratory tests show that if the conventional bond stress theory is applied to American Welded Wire Fabric's resistance to slip, fantastically high bond stress values of from 1,000 psi to 2,700 psi are computed. (See ACI Proceedings, Vol. 48, April, 1952.) Continuing bond test research under the direction of American Iron & Steel Institute has shown such good mechanical anchorage in the concrete as to permit this increase in the Tensile Strength of Fabric. American Steel & Wire is able to present this new product because of the tested bond values which enable designers to take advantage of a higher fabric yield point.

Just one example of the advantages of this improved fabric is in one-way slabs. The ACI Building Code 318-56 will allow unit tensile strength for fabric in main reinforcement of 30,000 psi in one-way slabs of 12-foot span or less, provided reinforcing members are ⅜" or less. Previously, designers were limited to 28,000 psi working stress with fabric, and only 20,000 psi with intermediate grade bars.

The new Welded Wire Fabric will cost no more. It will come in the same prefabricated rolls or sheets for easy handling and placing. Therefore, to get the improved product on your job at no extra cost, be sure to specify USS American Welded Wire Fabric.

USS American Welded Wire Fabric is available in a wide variety of styles, sizes, lengths and widths . . . in wire gauges from ½" diameter to 16 ga., and in longitudinal and transverse wire intervals of 2" to 16". Steel areas for all normal structural reinforcing in all types of construction are readily available. For more information on USS American Welded Wire Fabric—and its new tensile strength—write to American Steel & Wire, Dept. 9345, 614 Superior Avenue, N. W., Cleveland 13, Ohio.

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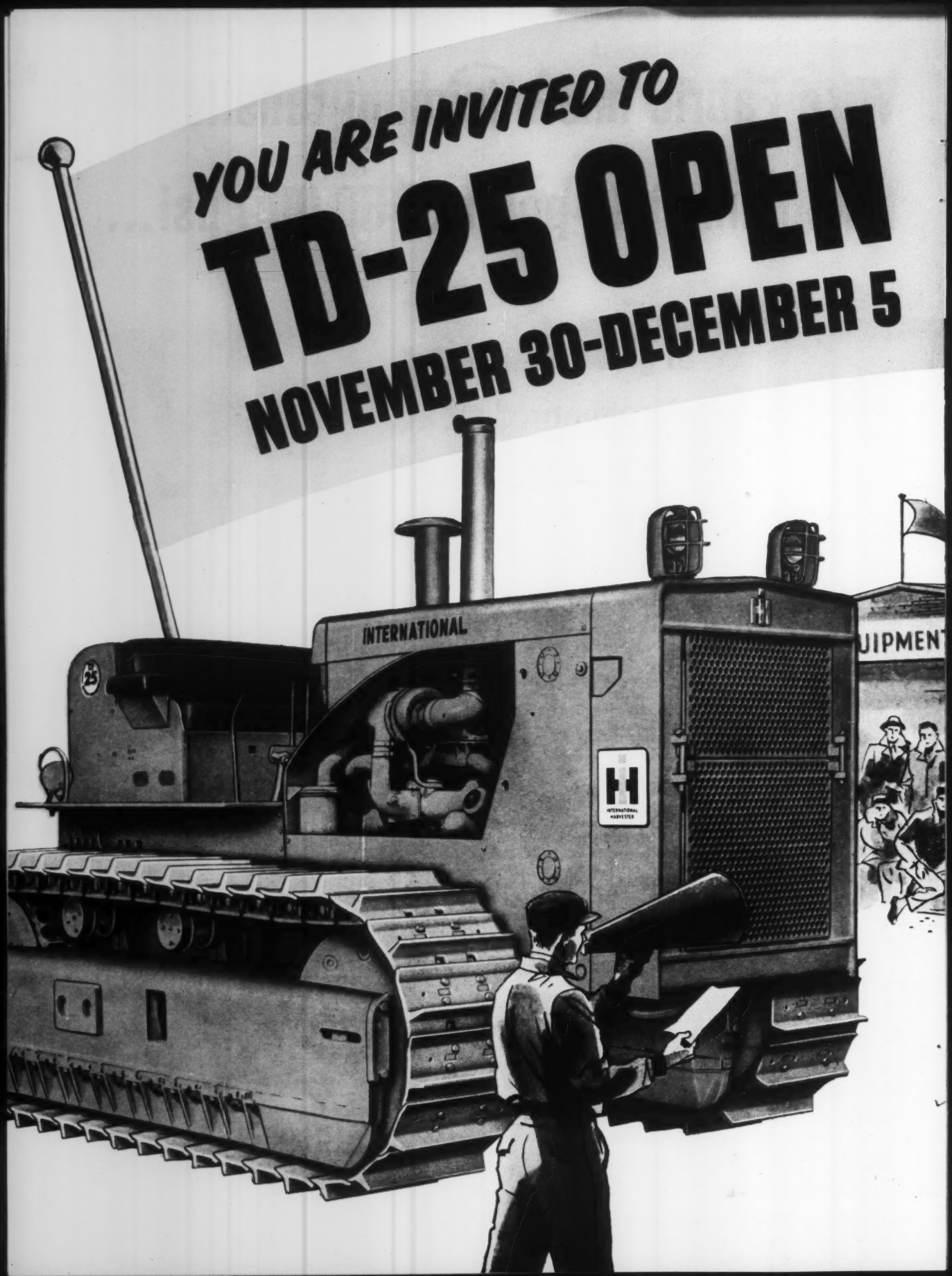
American Steel & Wire Division of United States Steel

USS

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

Always ask, *"is it Reinforced"*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INTERNATIONAL HARVESTER COMPANY
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An open invitation to profit-conscious contractors

At Open House, U.S.A., you won't be viewing "just another big tractor." Not on your life!

This is the big, new International TD-25's "coming out party." And the "25" is coming out "loaded for bear!"

At Open House, U.S.A., you'll preview a king-sized crawler that has more proven, high-output exclusive features than anything else on tracks...The new TD-25 is:

--the only king-sized crawler powered by the new 230-hp, 6-cylinder, direct-start DT-817 diesel--loaded with capacity-adding, life-prolonging features no other engine has!

--the only king-sized crawler with world-proved Planet Power steering, that gives you fingertip power-steering and Hi-Lo, on-the-go power-shifting. Full-time "live" power on both tracks adds payload capacity as no other crawler can!

--the only king-sized crawler with International-developed double-box-beam track frames, the industry's strongest; the only one carried on Dura Rollers--the rollers you can power-lubricate without affecting seal life or efficiency --the ones that make 1,000-hr lube checks practical!

--the only king-sized crawler with so many far-ahead features it can outearn competitive rigs up to 50%, on an amazing variety of tough jobs!

Watch for the word on when and where your Distributor will hold TD-25 Open House, U.S.A. And be there, for sure. Be one of the first to size up the profit-making advantages of the big, new International TD-25.

More productive power to you!

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International® Construction Equipment

International Harvester Co., 180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

NEWS OF MEMBERS

Donald S. Walter on September 1 ended a forty-year engineering career with the Bureau of Reclamation. For the past ten years Mr. Walter has been regional engineer for the Bureau's Region 1 with headquarters at Boise, Idaho. In this position he had primary staff responsibility over the design and construction of such major Reclamation projects as the Columbia Basin and Yakima Projects in Washington and the Hungry Horse Dam in Montana.

Richard E. Lander has become project engineer in the Investigation, Standardization and Improvement Department of the Keasbey & Mattison Company at Ambler, Pa. Before joining the company, which manufactures asbestos, asphalt and heat insulating products, Mr. Lander was associated with Harris-Dechant Associates of Philadelphia.

William Correale, superintendent of design and construction of school buildings for the New York City Board of Education during the most active school building phase in the city's history, recently resigned to resume private practice as executive vice president of a construction corporation building. He was appointed chief engineer for the Board of Education in 1952 and head of its Bureau of Construction a year later.

J. W. Vickrey, for the past three years deputy state highway engineer at Sacramento, Calif., became state highway engineer on October 1. Mr. Vickrey has been with the Division of Highways for forty-two years, and for the past twelve years has been closely identified with the California freeway program. He succeeds **George T. McCoy,** who is retiring after serving as state highway engineer since 1943. His retirement climaxes a notable career in California highway work, which began in 1927.

G. T. McCoy

J. W. Vickrey

John W. Hackney is now a vice president for BEACO Limited of Canada, with headquarters at Montreal. In this capacity he will be responsible for the engineering and construction of chemical, petro-chemical, and other process industry products being handled by BEACO. Until recently Mr. Hackney was manager of construction and cost accounting for the Diamond Alkali Company of Cleveland, Ohio.

Guy H. Goddard, Colonel, U. S. Air Force and since October 1957 chief of the Air Force Housing Construction Division, is responsible for design and construction of Air Force family housing, a $1 billion program.

Leonard Shapiro, a long-time member of the Newark College of Engineering faculty, has been promoted from assistant professor to associate professor in civil engineering. His fields of specialization are soil mechanics and traffic engineering.

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Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears... an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

This recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out of doors directly over the float well. Request BULLETIN 25 for complete details.

STEVENS HYDROGRAPHIC DATA BOOK

Invaluable for your reference file. Contains technical data on recorder installations, plus a wealth of hydraulic and conversion tables. $1 copy. (No COD's)

LEUPOLD & STEVENS INSTRUMENTS, INC.

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Specialists in hydrologic instruments for over half a century.

Merwin B. Clapp has been transferred from the Chicago Bridge & Iron Company's general sales staff to the company's Chicago district office as a contracting engineer. During Mr. Clapp's thirteen years with CB&I, he has served as design engineer in the Birmingham plant and in the Birmingham sales office.

George J. Bleul, until recently designing engineer in the office of engineer of bridges and buildings of the Baltimore and Ohio Railroad, Baltimore, has been appointed assistant engineer of buildings for the railroad. Mr. Bleul first joined the engineering staff of the B. & O. in 1947.

John B. Letherbury is the new director of engineering of the National Steel and Shipbuilding Corporation, San Diego, Calif. Mr. Letherbury was formerly affiliated with the New York Shipbuilding Company as vice president of engineering.

Elliott B. Roberts, Captain, U. S. Coast and Geodetic Survey, recently retired as chief of the Geophysics Division, after thirty-eight years with the Bureau. Since his retirement he has been recalled to active duty as special assistant for research and development. His acheivements include the organization of the Coast and Geodetic Survey seismic sea wave detection system and the invention of a deep sea tide gage.

Changes at Raymond Concrete Pile Company

Otis C. Struthers, assistant vice president of the Raymond Concrete Pile Co., will retire on December 1, after 36 years in charge of operations on the West Coast and in Salt Lake City.

A. Pearce Godley, former district manager in Kansas City, Mo., will take over the company's Los Angeles district, now directed by Mr. Struthers.

Charles R. Graff will succeed Mr. Struthers as assistant vice president. He will also continue in his present position as manager of the San Francisco district.

(*Continued on page 25*)

NEW! Monoflange valve is guaranteed drop-tight at 150#

The Henry Pratt Monoflange MK II is a top quality butterfly valve that fits between the pipe flanges of a fluid or gas line. **It saves weight, space and labor** because it eliminates a pair of flanges and requires only one bolting operation. **It eliminates gaskets** because the faces as well as the inside of the valve body are covered with rubber permanently bonded to the metal.

Low torque makes the Monoflange easy to operate, especially with Henry Pratt's **new SIDEWINDER manual operator.** Any type of power operator can be used if desired. Structural features include streamlined disc, one piece shaft, chevron packing and Nylon bearings. Various materials available for corrosive liquids.

Standardized and mass produced, this new valve offers famous Henry Pratt quality at a new low price . . . you can't find a similar valve that offers so much in quality or performance.

Complete information available. Water and gas flow data, valve sizing, operator selection in 26 page brochure. An ideal tool for the engineer working with and specifying valves. Write for Bulletin 10 AV

Creative Engineering for Fluid Systems

HENRY PRATT®

Monoflange MK-II
RUBBER SEAT BUTTERFLY VALVE

Henry Pratt Company, 319 W. Van Buren St., Chicago 7, Ill. • Representatives in principal cities

Curtain walls of precast concrete achieve dramatic interplay of light, color and texture

The unbroken whiteness of the end wall is in striking contrast to bright, blue-green spandrel panels of the sidewalls. And on the broad base wall below, light and shadow form bold patterns across the sculptured facing. 42 stories, and the tallest office building in the West, the Southland Life Tower is part of a $35,000,000 project in downtown Dallas, Texas.

It's all done with concrete panels. For the end walls and base, exposed quartz aggregate and white portland cement give surface roughness and brilliance. The smooth-faced spandrels are ceramic tile cast in concrete. The total effect is one more example of the unlimited design possibilities in today's new forms of concrete.

Architects and Engineers: Welton Becket, FAIA, and Associates, Los Angeles and Dallas. Consulting Architect: Mark Lemmon, AIA, Dallas, Texas. Structural Engineers: Murray Erick Associates, Los Angeles.

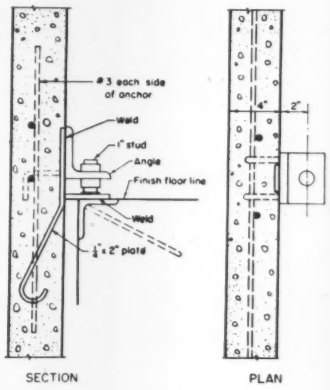
FOR STRUCTURES... MODERN **concrete**

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

Curtain walls go up fast with easy-to-hang concrete panels

At the Southland Center (both the Southland Life Tower and the Sheraton-Dallas Hotel) panels were lifted from trucks, fastened to frame and the joints were sealed as construction progressed. Erection of concrete panels is fast and easy, saves money and construction time. Today, in similar construction everywhere, the use of lightweight concrete gives added ease of handling, over-all weight reduction. And because wall units often need no back-up, reduced cross-sections are achieved with concrete panels.



Fastening simplicity. The drawing above shows one method of connection. The use of studs gives room for adjustment, so panels can be accurately aligned in case of slight irregularities in the building frame.

Portland Cement Association

News of Members

(Continued from page 23)

Harold B. Ellis, Lieutenant Colonel, U. S. Army, and associate professor of military science and tactics at Iowa State University, left on September 24 for Chinon, France where he will serve three years in the U. S. Army General Depot. Colonel Ellis has also been senior engineer instructor of Army ROTC at the University.

Harold L. Friend has retired after twenty-five years in government service —most recently as civil engineer for the Corps of Engineers at Tulsa, Okla. He is now associated with **E. L. Hammond,** city engineer of Lompoc, Calif., on subdivision layouts, new sewer layout and treatment plant as well as the many other jobs that fall to the city engineer of a rapidly expanding city.

Milton O. Schmidt, professor of civil engineering at the University of Illinois, left recently for a year in Zurich, Switzerland. Professor Schmidt is on sabbatical leave and has a National Science Foundation Faculty Fellowship to study geodesy and geodetic engineering at the Swiss Federal Institute of Technology on an independent and consultative basis.

Milton P. Barschdorf, Colonel, Corps of Engineers (retired), has joined Frederic R. Harris, Inc., New York City consulting engineers, as the firm's lower Mississippi Valley area representative, with headquarters in New Orleans, La. Colonel Barschdorf recently retired after twenty-one years of duty with the Corps of Engineers, his last assignment being district engineer of the Vicksburg, Miss., District.

Vernon E. Swanson, formerly structural design engineer for Graham, Anderson, Probst and White, of Chicago, Ill., has rejoined the Harza Engineering Company, after several years absence, as office engineer in their Lahore, West Pakistan office. Harza Engineering is presently engaged in developing the Indus and Jhelum Rivers and their tributaries for the Pakistan Water and Power Development Authority.

Richard C. Byce announces the establishment of the firm Richard C. Byce and Associates, Inc., at 428 W. South Street, Kalamazoo, Mich. Mr. Byce, president of the new firm, was formerly project engineer for the Miller-Davis Company. He is co-author, with Bruce G. Johnston, F. ASCE, of a book and several papers on the resistance of steel structures and industrial buildings to blast loads.

Sylvester E. Ridge, assistant chief in the Division of Development of the Bureau of Public Roads, Washington, D. C., has been promoted to the position of special programs coordinator in the office of the assistant to the Federal Highway Administrator. Mr. Ridge will be responsible for directing public roads activities in the coordination of water resources projects and highway development.

William A. Henderson has been appointed vice president of the Universal Engineering Corporation, a Boston firm specializing in the design of highways, bridges and other structures. He was formerly chief engineer of the Clarkson Engineering Company, Boston.

Harry L. Fox, Colonel, Corps of Engineers, U. S. Army, is being transferred from Washington, D. C., where he is acting assistant chief of engineers for military supply, to Atlanta, Ga., where he will be deputy division engineer for the South Atlantic Division. The transfer will be effective in December.

John B. Funk, newly appointed chairman of the Maryland State Roads Commission has been named by Governor Tawes to head a special committee to study the parking problem in the recently completed State Office and State Roads buildings area. **Benjamin E. Beavin,** designer of Friendship International Airport, Baltimore, will also serve on the committee as representative of the Baltimore Association of Commerce.

(Continued on page 122)

Chief of Engineers Emerson C. Itschner stands at attention while a gold star, symbol of his promotion from Major General to Lieutenant General, is pinned on his uniform by Secretary of the Army Wilbur M. Brucker and Mrs. Itschner. The ceremony took place early in September.

Pittsburgh Fab-Form, available in lengths up to 28 feet, 3 inches with 5/8-inch corrugation, is handled easily on steel joists by one man at St. Regis Church and School in Trafford, Pa. Contractor H. Justin Brown & Son, Mt. Lebanon, Pa., reported it took four men just one day to lay 10,800 square feet of Fab-Form. Fab-Form was sold and engineered by W. N. Dambach, Inc., Pittsburgh, Pa.

New Fab-Form by Pittsburgh Steel Cuts Floor and Roof Slab Costs, Gives Greater Length and Width

Fab-Form, a brand new addition to Pittsburgh Steel Products' line of quality construction products, builds in savings of materials and erection time for concrete floor and roof slabs.

New Fab-Form—longest and widest corrugated, permanent steel form for slabs poured over joists—reduces the number of end and side laps through its 32-inch cover width and extra length.

In addition, Fab-Form has an exclusive new welding method that is literally a snap.

Fab-Form is fabricated:

- In standard lengths, plus other lengths up to 28 feet, 3 inches—twice as long as most others.
- In a cover width of 32 inches.
- With deepest corrugation — a full 5/8-inch — of any standard steel centering.
- Plain or Bonderized with an exclusive baked-on duPont red oxide primer that provides weather protection and serves as an excellent primer base for further painting of exposed underside. Fab-Form's special protective finish prevents water stain or "white rust."

Fab-Form's uniform strength comes from high-tensile (90,000 to 100,000 psi), 27 gage, cold rolled steel sheet.

- **Ideal for School**—One of the first construction jobs in which Fab-Form was used was the new St. Regis Church and School in Trafford, Pa. Architect for the job was Ermes Brunettini, AIA, Verona, Pa. More than 33,000 square feet of Fab-Form supports three-inch concrete floor and roof slabs set on steel joists.

Thomas A. Laboon, job superintendent for H. Justin Brown & Son, general contractors from Mt. Lebanon, Pa., said that the deeper corrugations in Fab-Form helped make a stronger slab. Pittsburgh Steel's six-inch square mesh made of No. 6 gage wire was used for reinforcing.

Fab-Form's speed of installation also impressed Mr. Laboon. He said that it took four men just one day to lay 10,800 square feet of Fab-Form on roof joists. After sections were laid, welders using the unique Fab-Form Welding Washer Stick made plug welds to every other joist.

- **Easy as A, B, C**—Welders found using the exclusive Fab-Form Welding Washer Stick unusually simple. Pittsburgh Steel developed the unique stick so that each welder bent up the end washer on the stick, made his plug weld and snapped off the washer—in just seconds. This eliminates fumbling in heavy gloves for individual washers. Next, mesh was installed and the slab was poured.

"Everything came out exactly right with no scrapped material," said Mr. Laboon in commenting on the economy of Fab-Form. "The side and end-lapping worked out exactly right.

"On top of that," he added, "you know that when Fab-Form is down you have a material that will take a beating from men tramping on it, buggies and even rough weather.

"Later, after the slab is poured,

Deepest corrugation, 5/8-inch, of all standard steel centering is available with Fab-Form. Job Superintendent Thomas A. Laboon, left, shown with Pittsburgh Steel Products Salesman C. W. Bainbridge Jr., said deep corrugation helped make a stronger slab.

Rugged Fab-Form, longest and widest corrugated steel centering for concrete floor and roof slabs on the market, easily supports a three-inch roof slab. Fab-Form saves material and erection time.

you are confident that the same material will go a long way in helping provide sound construction."

Join the growing list of satisfied Fab-Form users. Your first application will convince you of Fab-Form's advantages . . . from Pittsburgh Steel Products Division, a leader in the construction products field for more than 30 years.

Write today for literature or, better yet, contact the nearest Pittsburgh Steel Products sales office listed here.

Pouring is no problem with Fab-Form. Here a buggy has rolled over Fab-Form without damaging the material. Six-inch square mesh made of No. 6 gage wire is from Pittsburgh Steel, too.

Exclusive Fab-Form Welding Washer Stick reduces installation time. After the end washer on the stick is bent up, the welder makes a plug weld and snaps off the washer. Then mesh is installed and slab is poured.

Fab-Form

Pittsburgh Steel Products

a division of Pittsburgh Steel Company

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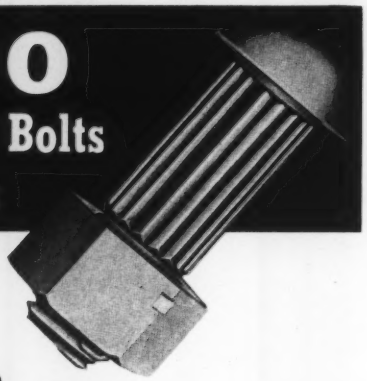
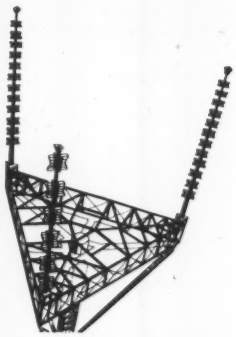
Structural Rib Bolts And Lock Nuts

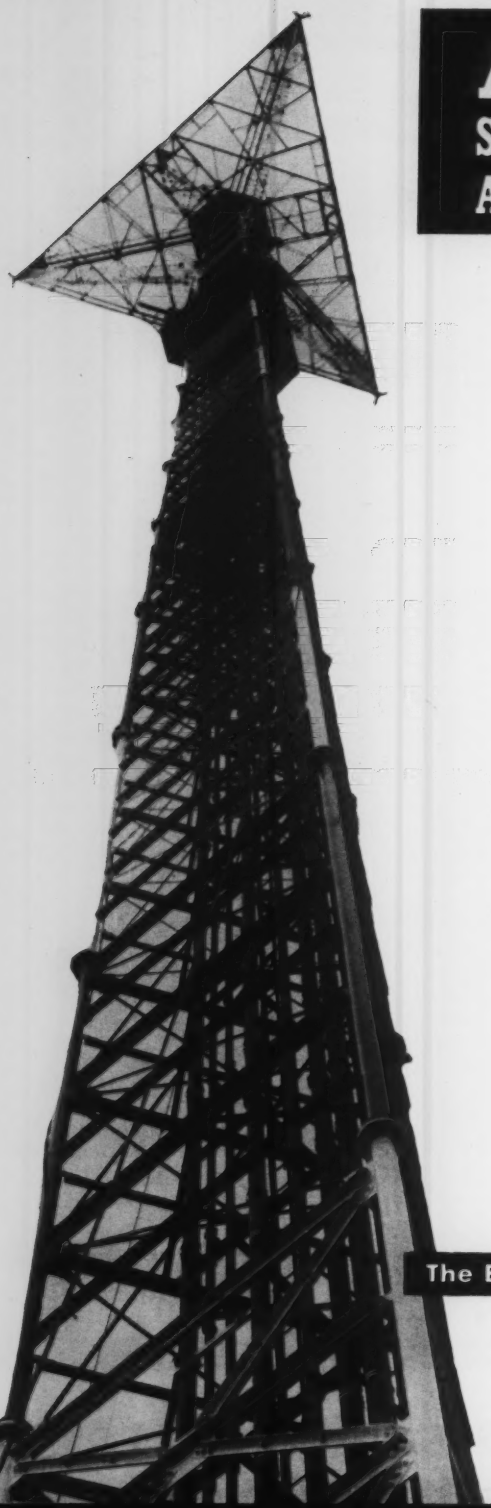


SPECIFIED FOR

The Baltimore Candelabra



FIRST TELEVISION TOWER TO SUPPORT THREE ANTENNAS ON THE SAME PLATFORM . . .



This giant tower now serving three stations in the Baltimore area is one of the most unusual structures ever designed for television transmission. Because of the rigid requirements established for the structure, fabrication and erection techniques had to meet stringent specifications. The most modern facilities and equipment were required to assemble its components. Each member was completely bolted as construction proceeded. Approximately 5,000 galvanized ANCO Structural Rib Bolts and ANCO Lock Nuts were used in the construction of this unique tower.

ANCO Structural Rib Bolts and ANCO Lock Nuts are first choice in the construction of all types of towers . . . for radio, television, high tension lines, micro-wave, radar antennas and reflectors, and others. They're easy to use . . . one man with a maul and wrench can install them. They're strong . . . actual tests show ⅝" diameter Structural Rib Bolts to be stronger than ¾" diameter rivets. They won't work loose, even under severe shock and vibration . . . in fact, they can't. And they're economical, too.

For more than 25 years, ANCO Structural Rib Bolts and ANCO Lock Nuts have been approved for all types of Federal, State and private projects. They can be furnished black or galvanized to meet your requirements. Write today for samples, technical data and prices without obligation.

The Baltimore Candelabra

Overall height: 730' / Tower design: Triangular in cross section, each side 12' / Antenna platform: Triangular, each side 105' long and 16' deep / Antennas: For WBAL-TV, WJZ-TV and WMAR-TV, each 100' high / Wind resistance: Built to withstand winds up to 165 miles per hour / Service elevator: Runs inside framework from base to antenna platform / Total weight: 500 tons of tower steel and guy cables / Design and fabrication: Dresser-Ideco Company, Division of Dresser Industries, Inc., Columbus, Ohio / Erection: Beasley Construction Company, Muskogee, Oklahoma.

AUTOMATIC NUT COMPANY
INCORPORATED
LEBANON, PENNSYLVANIA

. . . . . Am-Soc Briefs

▶ ▶ Annual Convention echoes. . . . The registration desk at the Statler-Hilton was a mad, mad place during the Washington Convention, with over 2,100 registering — unprecedented attendance for an out-of-New York meeting of the Society. . . . The spirit of the great capital with its strong international ties made itself felt in the technical program, with many of the 172 papers devoted to foreign engineering work. . . . The Civil Engineering Show, the third in Society history, included ten government and education exhibits. . . . The increasingly vital topics of registration, employment conditions, engineers in public practice, and engineering education were aired in four Conditions of Practice sessions.

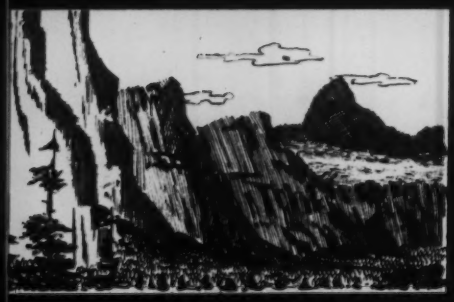
▶ ▶ The Board in Washington took the important step of authorizing group life insurance to ASCE members in what appears to be an especially advantageous offer. This insurance, of special value to younger members, is described in a Society News item.

▶ ▶ The Board adopted an unprecedented budget of $1,789,600 for its coming fiscal year. . . . endorsed a new look for ASCE Technical Publications (details in Society News). . . . reaffirmed the Society's 1876 stand urging adoption of the metric system. . . . established a Coordinating Committee on Civil Defense to stimulate civil defense activities within the Technical Divisions. . . . endorsed changing the name of the former Junior Member Forum to the Younger Member Forum. . . . approved establishment of a new Society prize for "outstanding professional practice activity." The prize is endowed by Edmund Friedman, former Director and Vice-President.

▶ ▶ The tempo of the drive for funds for the United Engineering Center has picked up gratifyingly, with ASCE (as of October 16) attaining almost 80 percent of its goal. However, speakers at the groundbreaking on October 1 (reported in Society News) stressed the need to keep on plugging. The Metropolitan Section, twenty-fourth and most recent addition to the UEC Honor Roll, has a high per capita quota of contributions, with only 788 of its almost 4,000 members pledging. Southern Idaho Section contributions are at a highly praiseworthy 166 percent.

▶ ▶ If some friend has allowed his membership in the Society to lapse you can tell him that reinstatement is a relatively simple and inexpensive procedure — how to do it is told in Society News. Pass the information on to all who should have a continuing interest in ASCE.

▶ ▶ Past-President Francis Friel will have a three-minute spot on the U.S. Steel Hour (CBS, Channel 2), November 18, 10 to 11 p.m., E.S.T. Mr. Friel will comment on the prize-winning bridges in the recent competition sponsored by the American Institute of Steel Construction.

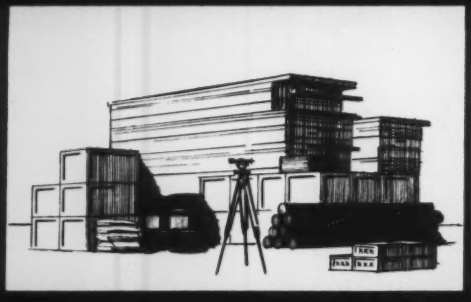


When the terrain looks like this

or like this

or like this

and you must get men



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▪ ▪ ▪

Expressways and off-street parking are no cure for downtown traffic congestion? This was the consensus of officials attending the 65th Annual Public Works Congress of the American Public Works Association held in Seattle this fall. Mass transportation was seen as the best answer to the congestion problem by new APWA President Jean L. Vincenz, director of Public Works for San Diego County (California).

▪ ▪ ▪

Quebec-Labrador iron ore reserves may be double original expectations? In the light of new information all previous estimates of deposits in the so-called Labrador Trough must be upped sharply, perhaps as much as 75 to 100 percent. It is even thought that the deposit—over 7 billion tons of easily beneficiable ore—will rival that of the Mesabi Range. The Labrador ore has a higher iron content, too.

▪ ▪ ▪

Ocean currents will be checked by a trail of soda pop bottles? As part of a large-scale study of ocean currents, the Coast and Geodetic Survey is releasing 2,000 soda pop bottles off the New England coast this fall to see where they go. Finders are asked, on cards in each bottle, to add to knowledge of the ocean by returning the cards to the Survey. Some of the bottles are expected to reach the Pacific.

▪ ▪ ▪

Canada may build a canal between Nova Scotia and the mainland? The 15-mile canal currently under study would cross the narrow strip of land between Nova Scotia and New Brunswick, connecting the Bay of Fundy and Northumberland Strait. The cost of a one-lock canal, recommended by Foundation Engineering, Ltd., Montreal, is estimated at from $80 to $100 million. Original plans were for a two-lock canal.

▪ ▪ ▪

A Pan-Asian Highway is on the drawing boards? The long hoped-for 7,000-mile route—extending east from Iran to the Malayan Peninsula—is being given serious consideration by the United Nations' Economic Commission for Asia and the Far East. Tentative engineering plans call for following the old caravan routes, where feasible, and building new highways where necessary. The highway would aid in the economic development of Asia by stimulating trade with Europe and encouraging tourist travel.

▪ ▪ ▪

Burying live atoms is an expensive business? The search for "burial grounds" for safe disposal of radioactive waste continues, according to the World Health Organization. Recent ocean studies show that there is "a kind of biological elevator in the sea which would bring radioactive materials from the deeps to the surface." The time required for this process in even the four-mile-deep Atlantic trenches is now seen as about five years instead of the centuries originally assumed.

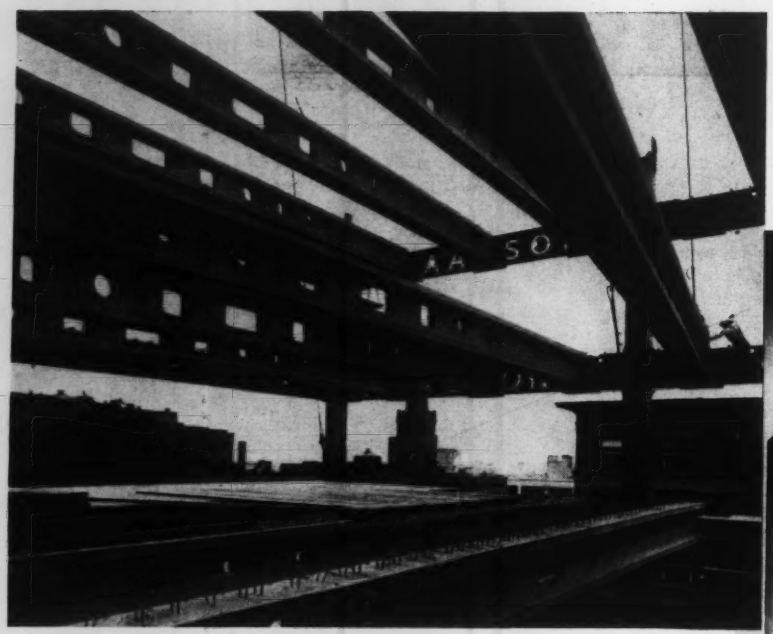
▪ ▪ ▪

Chicago waterways are full of pollution? Despite the efficiency of the Metropolitan Sanitary District, the largest sewage treatment system in the world, recent surveys reported by the *Chicago Tribune* reveal serious pollution. The reason for the paradox is seen to lie in the population density (5,000,000 people in a 920-sq mile area) and the tremendous industrial waste to be treated (equivalent to the domestic sewage of a city of 4,000,000). This means that even after more than 90 percent of all impurities has been removed, the treated effluent still has the pollution equivalent of untreated sewage from a city of 900,000—a heavy load on a stream with flow of only 3,258 cfs. The Chicago sanitary system was cited by ASCE in 1955 as one of the seven modern civil engineering wonders of the United States.

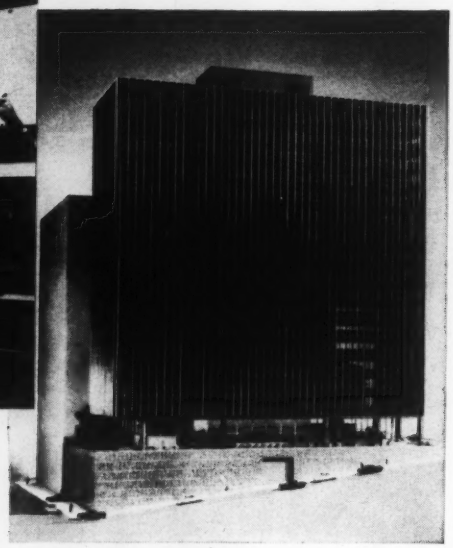
▪ ▪ ▪

Cooper Union is celebrating its centennial? The year-long celebration was officially launched on September 17 with cornerstone laying for a new School of Engineering. The original structure, opened in 1859 and still in use, was the first commercial building in the world in which structural steel was used. The famous old structure was also built with an elevator shaft—far-sighted Peter Cooper's idea—long before there were elevators.

New Heights for P/s Concrete



Growing Seattle Gets Unique New Skyscraper



Architects: **BINDON & WRIGHT,** Seattle
Consultants: **ANDERSON, BIRKELAND & ANDERSON,** Tacoma
SKIDMORE, OWINGS & MERRILL, San Francisco; **T. Y. LIN,** University of California
General Contractor: **HOWARD S. WRIGHT CONST. CO.,** Seattle
P/S Beams: **CONCRETE TECHNOLOGY CORP.,** Tacoma
Ready-Mix Concrete: **PIONEER SAND & GRAVEL CO.,** Seattle

● Prestressed concrete, virtually unknown a decade ago, has attained new heights in Seattle's 21-story Norton Building, the first U. S. structure over six floors to utilize P/S. The unique design uses 238 P/S beams in combination with a steel perimeter frame to support column-free floors in the 17-story tower. The use of P/S beams with lightweight concrete floors cut the building's dead load 20%.

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CIVIL ENGINEERING

Dreamers of the ASCE dream

FRANK A. MARSTON, President of ASCE, Partner, Metcalf & Eddy, Engineers, Boston, Mass.

Prepared from his address on taking office as President of ASCE, October 21, 1959

During the last half of the nineteenth century an unusual succession of dreamers crossed the stage of America, played their parts, spread their enthusiasm, inspired their followers, and left definite impressions on our way of life. Among these was James Laurie, the founder of ASCE, whose dream was a society of the future.

On the evening of November 5, 1852, twelve engineers and architects met in New York and formed the American Society of Civil Engineers and Architects (changed in 1868 to the present name). James Laurie, one of the principal dreamers in this group, was elected president, an office he held for fifteen years.

The first professional discussion in the new Society was by him on "The Relief of Broadway," a proposal to place railroad tracks above the level of the street in New York City. There were eight meetings in 1853 with an average attendance of six. At the end of the first year the membership had increased to forty-eight.

The fiftieth anniversary of the Society was celebrated in Washington, D. C., on May 20, 1902, at which time the membership numbered 2,603. Robert Moore, then President, said in his address, "The Engineer of the Twentieth Century" (ASCE *Transactions*, August 1902), that, in its first fifty years of life the Society had become "the leading organization of its kind in America."

He continued, "That, in the years to come, it will be a more potent factor in the advancement of knowledge and the promotion of high professional standards, is something we cannot doubt. This it will do in part by the intellectual stimulus of its papers and discussions. . . . But more important than the intellectual stimulus of our *Transactions* will be the moral stimulus of the personal contact and acquaintance made possible by our meetings. It is in fact hard to overestimate the value of such reunions in quickening the interest of those who take part in them. Nothing is so vitalizing as the meeting of those of like sympathies and common pursuits. Scattered, the embers may die out; in contact, they burst into flame."

This statement is most prophetic, as proven by the Society's growth in the 57 years since it was made.

From its small beginning 107 years ago, with 14 members, the Society now numbers over 43,000. It has 78 Local Sections with 62 branches. There are nine regional or District Councils. On the technical side, there are 14 active Technical Divisions, which during the fiscal year just ending have had 158 half-day sessions with 600 technical papers at ASCE conventions and specialty conferences. The volume of *Transactions* for 1959 contains 48 papers covering the latest information on theory, design, and construction. In addition, there have been published during the fiscal year 70 Journals containing 399 papers, plus twelve issues of current material on professional activities and engineering projects in CIVIL ENGINEERING, which goes to all members. The practice side of civil engineering is being actively considered through the Department of Conditions of Practice, a development of the past few years.

The foregoing data indicate the extent to which the functions of the Society have developed, the extent to which the dream of James Laurie has been realized and enlarged. All this is portrayed in greater detail in the 1959 Annual Report, which each of you will receive. While these achievements are rightfully a source of satisfaction, we cannot rest on our laurels. It is an obligation to the profession to carry on to even greater accomplishments, to develop means of greater service to the younger members, and to find ways of reaching a larger number of members by direct contact and not only by publications delivered by mail.

It is the practice to assign each member in the United States to the Local Section most appropriately located with respect to his residence. It is the custom of the Local Sections to invite the payment of annual dues in small sums from each of their members to provide funds for local activities to supplement the money sent to the Sections from the Society. The extent to which members assigned to Local Sections pay Section dues may be taken as one indication of the direct interest of the members in the Sections.

From available statistics for 69 Local Sections, 59 percent of the Local-Section-assigned members paid Local Section dues during 1958. The Texas Section, which covers a large area with 13 branches, collected dues from 57 percent of its assigned members, and the Los Angeles and San Francisco Sections each from about 60 percent. By contrast, the Alabama Section collected local dues from 99 percent of its assigned members, the Georgia Section from 93 percent, and the Rhode Island Section from 83 percent. The Metropolitan Section (New York area), with a very large assigned membership, collected local dues from only 39 percent.

Factors affecting a member's participation in Local Section activities may be distance from his residence to the

Section meeting place, or convenience of travel, or just plain lack of interest. There are other factors undoubtedly. The foregoing figures should not be taken as a criticism of Local Section officers or of Section activities. Many of the Local Sections are to be commended for their excellent programs. The facts are presented here to emphasize the need for more effective ways of bringing ASCE to more of its individual members.

ASCE is interested in research in the broad field of civil engineering, and must continue to be interested to an even greater extent. A reorganization of Engineering Foundation will apparently terminate the administrative and fiscal services that have been rendered by the Foundation to a number of research councils, including at least six in which ASCE is interested. The Board of Direction has offered to assume the sponsorship and fiscal administration service of these civil engineering research councils, but without commitment or token grants to the councils.

Society policies regarding national conventions are now established by an auxiliary administrative committee. Judging by the fact that the Society has accepted invitations from Local Sections to hold conventions each year through the year 1964, it may be concluded that such conventions are popular with the Local Sections.

Reaching more members

Can more of the members be reached through Technical Division conferences, or District council meetings? Are there too many Technical Division sessions at any one convention? Are too many subjects discussed at a convention or too little material presented on any one subject? The correct answers to these questions could result in a more informed and active ASCE membership.

The 1959 Annual Report shows that 268 committees were in operation in the past year within the structure of the 14 Technical Divisions. Nearly 1,300 members were serving on these committees. This indicates, statistically at least, the vast areas of study being undertaken to meet and solve the continuing flow of problems that confront the Society. It also is a warning that a watchful eye must be kept on the organizational structure so that it does not become unwieldy and professionally impotent to handle the problems that are of the greatest importance.

Conscious of this some time ago, the Board of Direction established a Task Committee on Administrative Procedure to develop ways and means of streamlining the administrative structure of the Society. This committee has worked diligently. One thing it has done is to make more effective use of the leaders of ASCE, the officers and Directors, for the many activities and studies under way. Through its recommendations, some committees in the important Department of Conditions of Practice have been merged because of overlapping interests. Some committees have been eliminated while others have been reduced in size.

Working in the same direction, a Task Committee on Professional Education conducted a comprehensive survey and reported its conclusions and recommendations only last year. ASCE committees are now hard at work implementing these recommendations. The aim is to improve curricula, attract more talented young people into the profession, and turn out engineers with greater potentialities.

The report also recommended greater effort in public relations at the national level, as well as on the part of Local Sections. As a result, a public relations program was undertaken and a department established for that purpose. Public awareness of the work of the civil engineer has increased considerably and there is no question but that the program will continue to put its imprint on the public consciousness.

In October 1956, President Lockwood made a survey to uncover the principal weaknesses of ASCE and to obtain suggestions for remedies. As a result, studies have been made and changes in operational details have been put into effect.

In October 1957, President Howson surveyed the past and projected his estimates into the future. The attendance at national conventions of ASCE was reviewed and suggestions offered for further investigation. He discussed also the problems of unity in the profession and the advantages of EJC as the organization to provide this unity among engineers.

In October 1958, President Friel emphasized the obligations of professional citizenship under ASCE. He threw his strength into the campaign for the United Engineering Center Fund as the No. 1 obligation of the Society.

Constitutional changes have put into operation new membership designations and qualifications. The whole Society structure has been critically examined.

Thus the Society has been going through a period of accelerated development. This coming year may be the time to take stock and to consolidate the gains made in the organizational structure. No doubt further streamlining will be necessary as the Society grows in membership, and as responsibilities and services increase.

An important step forward toward unity in the engineering profession has been accomplished through the statement of ASCE philosophy and policy issued by the Executive Committee of the Board of Direction. It was published in full in the September 1959 issue of CIVIL ENGINEERING.

A careful reading of the statement as published is recommended to all members of ASCE. Local Sections would do well to present it at meetings for information and discussion. One paragraph may be quoted here as being particularly significant:

Important statement on unity

"In ASCE, unity means cooperative effort in the common interest. The Society welcomes the opportunity to work with other organizations in the attack on and solution of common problems. At the same time, ASCE will continue to apply itself to the same activities and problems to advance the special interests of the civil engineer."

The new United Engineering Center on the United Nations Plaza in New York is an assured project. Over 70 percent of the $12 million required has been pledged, plans are complete, the contract has been awarded, and groundbreaking ceremonies were held on Thursday, October 1.

ASCE's quota is $800,000. Of this amount, as of October 16, 1959, about $635,000, or 79 percent, had been pledged by some 11,000 members. President Friel, with the loyal support of Society officers, Local Section officers, and other members of ASCE, deserves special commendation for the strong efforts that have been made in the fund-raising campaign. Executive Secretary Wisely and the Headquarters staff also have contributed measurably to the campaign.

The job is not yet complete. We are proud of our profession. Through our contributions to the United Engineering Center we can express this pride and take satisfaction in having had a part in the financing of this building which will demonstrate visibly the importance of the engineer in the world today. With continued effort, I am confident that we can reach our allotted goal by the end of this year, 1959.

The dream of James Laurie and his associates of 1852 has become a reality way beyond whatever expectations they could have had. We benefit today because of that dream.

We are entering a new fiscal year. As President, I look forward with great humility to the coming year, but with confidence because of the high quality of the men who make up the Board of Direction and our other divisions of leadership. May we all give of our best efforts for the success of ASCE.

Bus repair depot for Philadelphia's transportation system

Long trusses continuous over center column

STEWART C. BARNETT

Structural Engineer, Camden, N. J.

For Philadelphia's bus repair depot, the engineer was given the interesting problem of supporting a roof structure over two spans of 176 ft, or a total length of 352 ft. After several preliminary designs were prepared, it was realized that a considerable saving could be realized by making two spans continuous over the center column. After several trials it was found that 12 ft was the maximum depth possible for a truss that was to be shipped in one piece. Also, a truss 176 ft long was difficult to ship, so the maximum dimensions were set at 12 ft x 88 ft, or a half truss weighing 14½ tons. The depth of the outside half was tapered from 8 ft 6 in. to 12 ft 0 in. to give a pitch to the roof, and also to save height in the wall and columns. The inside half was given a constant depth of 12 ft 0 in. for shipping purposes, and also because it was found difficult to connect a tension strap over the center unless the top chord was level. A pitch to the roof was introduced by raising purlins to different elevations above the truss.

Ten bays each 32 ft wide were decided on, for economy in steel and to suit the arrangement of overhead doors in the side walls. The clear height was fixed by the architect at 15 ft 6 in. to the bottom chord. The gypsum roof slab is supported on welded long-span trusses 20 in. deep, spaced 8 ft 0 in. center to center.

The live load was set at 30 psf by the Building Code, and the dead load was computed at 33.5 psf, including 1.0 psf for wires and pipes. This gave a panel live load of 7,680 lb and a panel dead load of 8,580 lb, totaling 16,260 lb for a panel 8 ft by 32 ft.

Step No. 1. As a starting point, the end reactions were assumed at ⅜ wL and the center reaction 1¼ wL, as for a two-span continuous beam. Using these reactions, a preliminary design was made.

Step No. 2. Then, assuming the truss to be a girder of variable mo-

Outside half of each of the 176-ft trusses tapers in depth from 8 ft 6 in. to 12 ft. Center section has constant depth of 12 ft. The steel was erected from the basement before the concrete for the first floor had been placed.

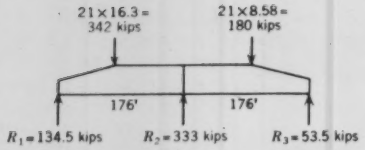
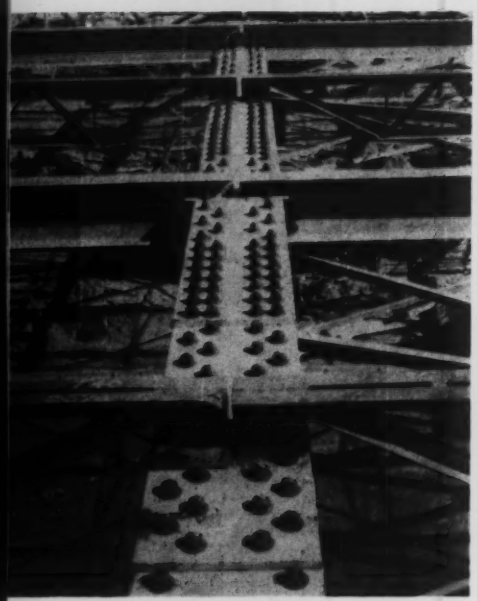


FIG. 1. Live load on the left span only, gave the reactions shown.

ment of inertia, using the chord angles only, and by means of the theory of least work, the center reaction was calculated from the formula,

$$R_2 = \frac{\Sigma M m\, dx}{I} \div \frac{\Sigma m^2\, dx}{I}$$



Then $R_1R_3 = 122$ kips, and $R_2 = 439$ kips. The corresponding assumed values were 126 and 431 kips.

Using these reactions, the stresses were refigured and the sections corrected.

Step No. 3. The truss was refigured more exactly, using the same theory on a continuous truss with the formula,

$$R_2 = \frac{\Sigma SuL}{A} \div \frac{\Sigma u^2 L}{A}$$

This looks simple but it turned out to be a very laborious project. A unit load was assumed at each panel on the left truss, and zero loads on the right truss. The answer was $R_2 = 13.4$ for the unit panel load.

For Case 1, that is, live load on both spans, not including wp at the center, the computation was:

$$\begin{aligned} R_2 &= 16.3 \times 26.8 = 436.0 \text{ kips} \\ R_1 = R_3 &= 16.3 \times 21.0 = 342.3 \text{ kips} \\ &\quad - 218.0 \text{ kips} \\ \text{Total} &\quad 124.3 \text{ kips} \end{aligned}$$

For Case II, live load on the left span only, not including wp at the center, the computation was:

$$\begin{aligned} R_2 &= 7{,}680 \times 13.4 = 103.0 \text{ kips} \\ &+ 8{,}580 \times 2 \times 13.4 = 230.0 \text{ kips} \\ \text{Total} &\quad 333.0 \text{ kips} \end{aligned}$$

Total $W = 7{,}680 \times 21 + 8{,}580 \times 42 =$
$161 + 360 = 521$ kips
$R_1 + R_3 = 521 - 333 = 188$ kips

Taking moments about R_2 (see Fig. 1),

$176\,(R_1 - R_3) = 88\,(342 - 180)$
$R_1 - R_3 = 81$ kips; $2\,R_1 = 269$ kips
$R_1 = 134.5$ kips; $R_3 = 53.5$ kips

From these reactions, the stresses were again computed, and the sections corrected accordingly.

Step No. 4. Finally the deflection of the truss was computed by the same method, using a unit load at Point 9, which was judged to be the point of maximum deflection. This point was 72 ft from the left end.

Live load was figured on the left truss only. By the formula,

$\Delta = \frac{\Sigma SUL}{AE}$, the deflection was computed as:

4.84 in. for live load on one side
4.17 in. for live load on both sides
2.2 in. for dead load only

A camber of 5 in. had been assumed, which turned out to be very close. The trusses were figured as pin ended. It was realized that the stiffness of the columns could be taken into account, but that this would reduce the stresses slightly. The stiffness of the columns was neglected to give a larger factor of safety.

About 40 ft from the center column, a point was found where the stresses in the chords are reversed, indicating a point of contraflexure. This point was 0.25 L for Case I and 0.22 L for Case II. It is interesting to note that the stresses build up rapidly from this point to the center column, so that several additional cover plates are required near the center. The trusses were well braced at the top and bottom chords in alternate bays, and sway frames were used 24 ft 0 in. apart and 16 ft 0 in. from the columns, making a very stiff and rigid structure.

The maximum tension in the top chord was + 684 kips, requiring a strap 18 in. x 2½ in. (18 in. x 2¾ in. was used), with sixty 1-in. rivets on each side. Shop assembly of two trusses, including the strap and center column, and reaming of holes to fit was considered, but it was found to require a space 351 x 42 ft, which would be very difficult and expensive to provide. Since the fabricator guaranteed that the straps would fit, shop assembly was not required. The holes did fit perfectly, with one or two exceptions, showing excellent shop work.

The bottom-chord stress of − 684 kips was taken through the column by four stiffener angles 6 in. x 6 in. x ¾ in., milled to bear, and the bottom chord was milled to bear against the column flange. High-tension bolts were used for all field connections at truss splices and column connections. These bolts worked out very well, although close supervision was found necessary to maintain all torsion wrenches at the required pressure. An inspector was on the job watching the erection at all times and checking all bolts. Only a very few were found to be loose.

The trusses are supported on con-

Top and bottom truss details at the center columns. Above are bolted tension straps. Note provision for expansion of purlins. View from below shows milled joint at lower chord. Note sway bracing placed 16 ft from center column.

crete caissons about 36 ft in diameter. These caissons extend down to rock, a decomposed mica-schist that provides a good rigid foundation.

An interesting erection feature was due to the fact that half of the building was virtually two stories high since an unfinished basement was to be left below the first floor. The engineer figured that the erection cranes would be too heavy to be supported by the floor system, so it was agreed that all the trusses would be erected from the basement before construction of the first floor. Thus the center columns were designed to support the roof trusses without a floor system at the first floor. To reduce the unsupported length of these columns, temporary struts (10 WF 33) were connected in a line between the columns, just above the floor line, and were removed after the floor system was completed.

It will be noted in the sketch at right, Fig. 2, that the concrete retaining walls, and a strip of floor slab 15 ft wide, were constructed on each end and shored up to support the end columns. The trusses were erected by two cranes using pick-up points about 32 ft from each end.

The length of the trusses created an expansion and contraction problem. For a change of 100 deg F, the expansion in 176 ft would be 1.4 in. However it was believed that after the roof and walls were completed, the maximum variation would be from 50 to 90 deg F, or about 40 deg, corresponding to a movement of 0.57 in. in the end columns. To avoid cracking of the masonry, the columns were separated from the brickwork by a bituminous expansion joint. Incidentally, for architectural reasons the outside flange of the columns was left exposed to the elements. This is not entirely satisfactory from a structural standpoint.

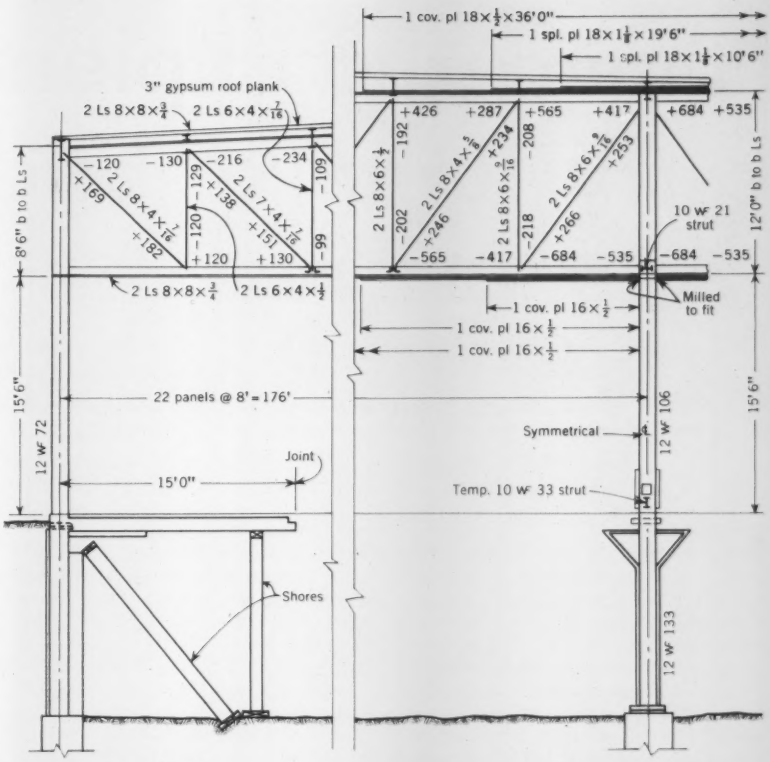
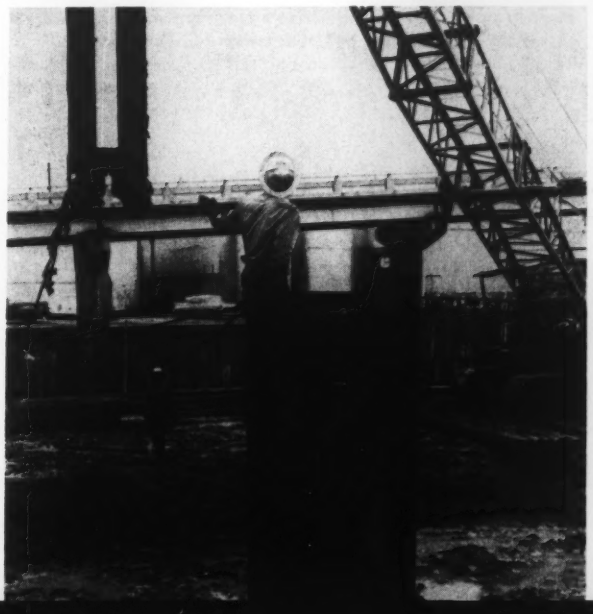


FIG. 2. End and center supports for trusses of 176-ft span. Trusses are continuous over the center support to economically provide an extensive open area for the bus garage. Note temporarily braced floor section at left.

The importance of a thorough check of the shop details of trusses should be emphasized. The strength of such details can be sadly impaired by a few misplaced rivets, or cuts.

The trusses were fabricated by the Bethlehem Steel Co., with field work done by the Ralph Cornell Erecting Co. Inspection was handled by the Conwell Testing Laboratory. The general contractor was McCloskey and Co.; the architect was Thalheimer and Weitz. The owner is the Philadelphia Transit Company. The structure was designed by the writer.



Diesel fuel lubricates interlocks

Diesel fuel has been found useful in getting steel sheetpiling to slide smoothly down the interlocks. Before a pile is hoisted into place for driving, its edges are painted with diesel fuel. This procedure, it is reported, loosens up the rust and scale so that the piling goes together with ease. The method is reported by Gulf Oil Corporation, from an R. P. Farnsworth & Company job on the two-million-dollar underpass beneath the Airline Highway-Causeway Boulevard interchange in New Orleans, La.

Hammerhead piers carry turnpike bridge

D. B. STEINMAN, F. ASCE, Consulting Engineer, New York, N. Y.

C. H. GRONQUIST, F. ASCE, Associate Engineer with D. B. Steinman, Consulting Engineer, New York, N. Y.

Each roadway of the James River Bridge on the Richmond-Petersburg Turnpike is supported separately by hammerhead piers. A total of 100 of these piers carries the 4,182-ft-long bridge over the historic James River at Richmond. Single-column piers, set to the angle of the stream, allowed square rather than skew span construction. This method of construction was also advantageous in pier location for the northern half of the bridge. Situated in downtown Richmond, this part of the bridge passes over viaducts that carry the Southern Railroad, the Chesapeake and Ohio Railroad, and the Seaboard Airline Railroad.

The 90-ft-wide James River Bridge is the largest structure on the recently completed Richmond-Petersburg Turnpike in Virginia. Since the river is shallow and navigable only by small boats, 88-ft steel, simple-beam, composite spans proved economical for the river portion of the project. Simple-beam spans up to 96 ft in length, and girder spans up to 115 ft in length, were employed over land in Richmond, although a 260-ft skew truss spans the railroad parking lot at the Main Street Railroad Station to meet requirements of the Seaboard Airline Railroad Company. The south half of the bridge is on tangent; a 1-deg curve begins near the north bank of the river, and a 4-deg curve occurs beyond Main Street at the skew truss span.

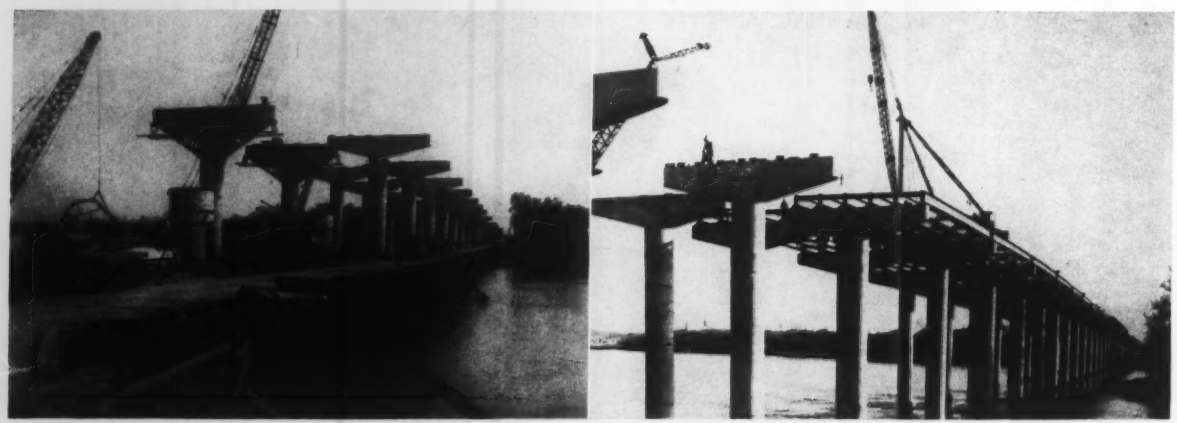
The reinforced concrete deck consists of two 40-ft roadways separated by a 4-ft mall, with a 2-ft walkway on each side. Concrete parapets are surmounted by aluminum railings 18 in. high, in which the electrical cables for the roadway lighting system run.

The two-year construction period required fast scheduling and careful coordination of the operations of all contractors. In order to open the bridge and turnpike to traffic by June 30, 1958, it was necessary to start placing the 7-in. concrete deck slab in the previous December and to continue throughout the winter months. This was done with the use of heated aggregates, but no special protection was given to the deck concrete after placing, other than to cover it with plastic blankets and tarpaulins.

Pier design

The columns for all the hammerhead piers were made 7 ft 9 in. in diameter, and the 44-ft top struts or hammerheads for all the piers, except for those in a few longer girder spans, have the same dimensions, to minimize vari-

Working from a timber trestle, Bowers Construction Co. built the river piers, pouring the columns in maximum lifts of 16 ft. Hammerhead forms were made self-supporting by use of trussing bearing against the column concrete. At right, a traveling derrick on the roadway deck sets steel brought out on a car operating on two of the adjacent roadway beams.



A rolling bridge was used for the floating of the concrete deck. Straightedging, belting, and brooming followed.

The $7,370,000 James River Bridge is the largest structure on the recently completed Richmond-Petersburg Turnpike.

ations in the forms, which were specified to be of steel. The contractors designed the hammerhead form to be self-supporting by use of trussing bearing against the column concrete. The column forms were made up in heights of 2 ft and 4 ft, and the columns were poured in maximum lifts of 16 ft, without guying. All pier forms were covered with 2-in.-thick insulating material to afford winter protection to the concrete.

Construction of foundations

For the river spans the contractor constructed a timber trestle from which to build the river piers. The foundations for these piers were placed under water in steel sheetpile cofferdams that were unwatered to as great an extent as possible in making the excavation through decomposed granite to hard rock. A retarding densifier, Plastiment, was specified for all concrete on the project, and care was exercised in placing the tremie concrete to insure maintenance of a reasonably level surface, with the result that extremely little laitance was formed in the underwater concrete. The 4-ft-deep, reinforced-concrete dry pad placed on top of the seal received the pier column.

Both abutments and most of the land piers were founded on steel H-bearing piles varying in length up to a maximum of 50 ft. All other land piers were carried to hard rock.

Steel superstructure

The 36-in. beam spans, 88 and 96 ft long, are of composite construction with ¾-in. steel-stud shear connectors that were welded in the field after steel erection. The 260-ft deck-truss span, employing low-carbon alloy steel for the heavier chords (since grade considerations limited the depth to 22 ft 6 in.), is fixed at the north end and expands at the south end. All lateral wind at the south end is taken by the pier at the southwest bearing, and the southeast corner of the truss is supported on a double pinned column with spherical bearings in order to minimize horizontal forces and permit minimum dimensions for this pier in the small space available between the railroad viaduct and a large arch sewer.

Steel erection started at the south abutment. A deck traveler derrick was moved along the west roadway steel, and steel was brought out to the point of erection on a car that ran on two of the east roadway beams. Erection, carried out in this manner, proceeded across the river and northward into the city. At the north end of the project, erection was done by a crawler crane operating from the ground, including erection of the new truss span, which required the use of two steel falsework bents.

Concrete deck

Complete mechanization was employed in placing, screeding and finishing the roadway concrete. Placing of the transit-mix concrete for the deck slab followed closely behind steel erection, beginning at the south abutment and proceeding north. Concreting began on the west or southbound roadway, the concrete being brought to the point of deposit by cars operated on a monorail laid on the beams of the northbound roadway.

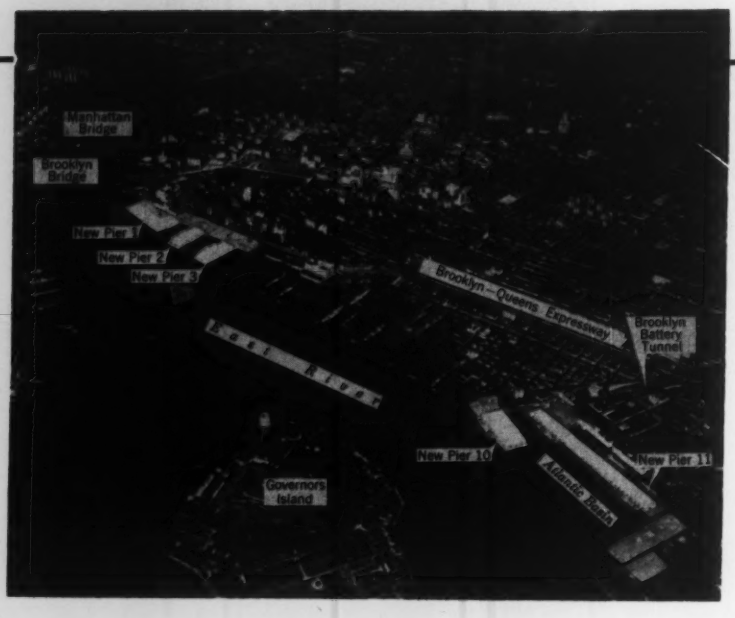
A heavy, machine-operated screed ran on rails set over the curb and mall beams. This was followed by a bridge running on the same rails, from which the longitudinal floating was done, followed by straightedging, belting and brooming. A second bridge followed, from which the concrete was sprayed with curing compound. Some of the slabs on the northbound roadway were screeded with the use of three 15-ft transverse screeds, which were moved longitudinally on two light screed supports and the two main rails, but this method of screeding was not completely satisfactory, and was abandoned.

Following completion of steel erection in April 1958, the placing of the deck slab and concrete parapets was completed in June to permit opening of the bridge to traffic June 30, 1958. The total cost of the project was $7,370,000, including the steel piles, which were purchased directly by the Richmond-Petersburg Turnpike Authority. Individual contractors are listed in Table I.

Parsons, Brinckerhoff, Hall and Macdonald were consulting engineers to the Richmond-Petersburg Turnpike Authority on design and supervision of construction of the entire turnpike, with M. N. Quade, F. ASCE, partner in charge, and D. R. Neff, Resident Project Manager. D. B. Steinman was consultant on the design and supervision of construction of the James River Bridge. For D. B. Steinman, C. H. Gronquist, F. ASCE, was in general charge of the project, and S. R. Ransom was Resident Engineer.

TABLE I. Contractors on the job

Firm	Item	Cost
Bowers Construction Co., Raleigh, N. C.	River-span foundations	$1,214,000
T. A. Loving Co., Goldsboro, N. C.	Foundations for north half of bridge	$1,210,000
American Bridge Div., U. S. Steel Corp.	Steel superstructure	$3,230,000
Thorington Construction Co., Richmond, Va.	Concrete deck	$1,518,000
J. I. Hass Co., Jersey City, N. J.	Structural-steel field painting	$ 60,500



Five new piers along Brooklyn waterfront have been completed by the Port of New York Authority.

New York City's newest fireproof piers are carried on thousands of pressure-creosoted wood piles. Some of the piles, driven in water up to 35 ft deep, are designed for loads up to 25 tons. A feature of interest in connection with the fireproofing is the omission of below-deck sprinkler systems or fire bulkheads.

Erection of superstructure starts on Pier No. 2, which is complete except for fender system. Note creosoted bearing piles encased in concrete cylinders above half tide elevation.

Fireproofing for pier substructure makes use of a pair of stay-laths through-bolted to each timber bent pile. A bottom form of ½-in. asbestos-cement plank rests on the stay-lathing. On the bottom forms are set the precast reinforced concrete cylinders, of 20-in. ID, which are later concreted into the deck.

FIREPROOF PIERS

on creosoted wood piles

RALPH H. MANN, F. ASCE, Senior District Engineer,

American Wood Preservers Institute, New York, N. Y.

The piers are part of a 7-year program believed to be the largest marine terminal development ever undertaken in the New York part of New York Harbor. Rapid progress is being made by the Port of New York Authority toward the completion of this $90 million program along the Brooklyn shore of the East River.

About three years ago the Authority purchased some two miles of choice Brooklyn waterfront extending southward from the Brooklyn Bridge to the Atlantic Basin. The overall plan for this area contemplates the replacement of 25 obsolete piers by 10 new, one-story structures completely fire resistant and fire protected. When completed, the new pier structures will provide 25 berths for modern cargo vessels together with about 90,000 sq ft of shedded space per vessel berth, or a total of 2,250,000 sq ft of enclosed pier sheds. In addition to the areas under cover, wide aprons and extensive truck service areas are provided.

The first terminal completed in the program was Pier No. 11, built in Atlantic Basin and dedicated on June 4, 1958. This is a quay type of structure 2,100 ft long, a solid-fill pier providing alongside berths for three ships. The fender system is entirely of pressure-creosoted oak piles and timbers. Four additional piers—Nos. 1, 2, 3 and 10—have been completed.

In the construction of these four piers, about 10,000 pressure-creosoted Southern pine and Douglas fir bearing and brace piles, ranging in length from 55 to 99 ft, were used. In addition, over 1,000 pressure-creosoted red oak fender piles were installed together with many thousands of board feet of pressure treated red oak timbers for chocks, walers, and other similar uses.

In three of the four piers—Nos. 1, 2 and 10—the actual design load per pile, based on core borings at the site and load tests on the piers, was 20 tons, and the number and spacing of piles was based on that figure. Pier No. 3 has an actual design load per pile of 25 tons.

Five other piers are planned for construction during the remainder of the seven-year period of the Port Authority program. The rehabilitation of an existing pier in Atlantic Basin will bring the total number of piers in the program to eleven. It has been stated that, on completion of the program, about 2,500,000 tons of general cargo, or about 25 percent of the general cargo moving through the Port of New York, will be handled at this terminal.

Timber bearing piles

The specifications provided that timber bearing and brace piles of southern yellow pine or Pacific Coast Douglas fir, conforming to Grade B, ASTM D25-55, "shall be pressure treated with preservative to refusal with a minimum retention of 20 lb per cu ft for southern yellow pine piles and 14 lb per cu ft for Douglas fir piles." The preservative "shall conform to the requirements for Grade B creosote-coal tar solution." It was further specified that "breaks, cuts, or other damaged surfaces of treated timber piles shall receive three applications of a mixture consisting of 60 percent creosote oil and 40 percent roofing pitch or shall be brush coated with three applications of creosote oil and covered with roofing pitch."

The bearing piles were specified to be driven with a hammer that would produce not less than 15,000 ft-lb of energy per blow. It was further specified that in the placement of these bearing piles, a lateral tolerance exceeding 3 in. for pile placement "will not be permitted." The maximum slope of a bearing pile as driven was set at 2 percent.

Creosote-treated fender system

Approximately 1¼ miles of creosoted pile and timber fenders surround and protect these four piers from the impact of ships. The piles, which ranged in lengths from 60 to 70 ft, were red oak and were pressure treated to a 10-lb retention of creosote per cu ft of wood.

Red oak fender timbers, for chocks, wales, etc., were pressure treated to a net final retention of 6 lb of creosote per cu ft of wood by the empty-cell process, following American Wood-Preservers' Association standards.

Fender piles were specified to be driven with their tops 12 in. closer to the bulkhead than their required final locations. These piles were then sprung out for installation of the fender system.

Design of Pier No. 2

Pier No. 2 was designed to provide about 90,000 sq ft of covered area for each of the two berths, with 30-ft side aprons and a 20-ft end apron. (See ASCE *Proceedings* Paper 1639, "Waterfront Structure Design for Varying Conditions," by W. C. Stevens and J. S. Wilson.) Column spacing for the pier shed is about 40 x 58 ft. No railroad trackage is provided on Pier No. 2. The berthing depth alongside is a minimum of 32 ft and the substructure construction is completely fireproofed.

The deck design live-load is 500 psf or the H20-S16 Truck Loading, with the lateral load at ship side to be that imparted by a 10,000-ton ship.

A series of borings made at the site disclosed some 20 ft of soft organic silt, a dense sand layer from 15 to 20 ft thick, and a silty clay varying in thickness from 30 ft at the bulkhead line to 70 ft at the pierhead line. Beneath this clay layer lies bedrock, which is from 90 to 130 ft below mean low water. It was evident from a study of these subsurface conditions that either of two types of piles could be used—a heavily loaded steel pile driven to rock or a lightly loaded timber pile supported in the sand layer. Pre-

Steel reinforcing rods, placed between the encased pile and the concrete cylinder, extend 5 in. above top of cylinder, where they are bent horizontally for incorporation into the deck slab. Corrugated sheet-metal forms for the deck slab have been hung from the tops of the cylinders.

cast concrete piles were ruled out because of the length required.

On the basis of these core borings, and subsequent verification by load tests on piles, it was determined that a design load of 20 tons was in conformance with good engineering practice. Bids were taken on the construction of the piers on the basis of competitive designs for concrete-filled steel pipe, steel H-sections, and pressure-creosoted wood piles.

Nine bids were submitted, ranging from a low of $2,584,850 to a high of $3,972,630. The low bid and the next three bids were based on creosoted timber piles. The lowest bid for steel piles was $3,570,500. (It is of interest to note that the same contractor, Charles F. Vachris, Inc., submitted the low bid —$2,714,200—among six bidders on Pier No. 3, for which only pressure-creosoted piles were specified.)

The substructure of Pier No. 2 is of special interest in that two subway tunnels of the New York City Transit Authority run beneath it, for the full length of the pier near its south face. The mid-point between these two tunnels is 50 ft north of and parallel to the south face of Pier No. 2. The two tunnels are each 17 ft 6 in. in outside diameter and are separated by a clear distance of 9 ft 6 in. They vary in depth from 40 to 60 ft below mean low water. Because of the requirements for spanning these tunnels, it was determined that three rows of steel pipe piles, concrete filled, with design loads of 100 tons each, should be used between and alongside of the tunnels. A total of 3,014 pressure creosoted timber bearing and batter piles of southern pine or Douglas fir and 197 steel pipe piles with an average length of about 105 ft make up the substructure of Pier No. 2. This pier is 350 ft in overall width and has an overall length of about 600 ft.

A typical pile bent containing the three pile support clusters for the superstructure columns contains 54 vertical and 2 batter piles of creosoted wood plus 3 steel pipe piles, the latter supporting the two subway tunnels. Pile bents are spaced generally 10 ft on centers, and the piles within the bent are normally spaced 6.4 ft apart, with 64 sq ft of deck area per pile.

Pier No. 3, which has been built immediately south of Pier No. 2, is of almost identical design and construction except that it is underpassed by no subway tunnels and has its entire substructure carried by 3,440 25-ton pressure-creosoted timber piles. Pier No. 3 is 610 ft long and has the same width as Pier No. 2, that is, 350 ft.

Pier No. 1

Pier No. 1, built almost simultaneously with Pier No. 2, by the Horn Construction Co., Inc., is located directly south of the Brooklyn Bridge. It occupies the sites of four of the old piers, Nos. 3, 4, 5 and 6. One of the old piers rested on creosoted piles, which after 68 years were in an excellent state of preservation. The old pier was raised in the course of the reconstruction work.

The size and shape of Pier No. 1 were controlled by the location of the existing United States pierhead line. At its northern extremity this pier extends 270 ft out from the bulkhead to the pierhead line; then it runs southward for 1,050 ft, at which point it returns eastward to the existing bulkhead over a distance of 500 ft. This pier is a three-berth facility, but its north face is suitable for shallow-draft ships only. Basic criteria and subsoil conditions for this pier were the same as those previously described for Pier No. 2.

The new Pier No. 1 includes one of the old timber piers, No. 6, which was built in 1930 by the Board of Transportation. The untreated timber piles and reinforced concrete deck of the old pier were in excellent condition and were incorporated in the new pier by taking advantage of existing fire walls and extending existing nozzle openings up through the new deck surface. This old Pier No. 6 also spans subway tunnels. New Pier No. 1 extends both to the north and to the south of old Pier No. 6. The part that extends to the north of the old pier consists of a solid fill retained behind a steel sheetpile bulkhead, and the part that extends south of the old pier is founded on creosoted timber piles of 20-ton capacity. A total of 1,375 creosoted timber piles were included in this southerly part of the new Pier No. 1.

Pier No. 10

Pier No. 10, constructed by the Frederick Snare Corp., is located on the Brooklyn shore north of the main entrance to Atlantic Basin on the east side of which Pier No. 11 is situated. Pier No. 10 is primarily a solid-fill pier surrounded on two sides by extensive areas supported on creosoted piles. A total of 1,886 creosoted pine piles ranging in length from 60 to 65 ft, and each carrying 20 tons, were installed in the substructure of Pier No. 10.

Pile fireproofing

The contract specifications provided that "all timber piles except fender piles shall be fireproofed." It was specified that this fireproofing be done with "prestressed concrete pipe similar and equal to prestressed concrete cylinder pipe (Specification SP5-56) as manufactured by the Lock-Joint Pipe Company, except that the pipe shall have plain ends instead of bell-and-spigot ends."

The basic design developed by the engineers of the Port Authority for fireproofing the substructures of Piers Nos. 1, 2, 3 and 10 provides for the attachment of a pair of 3- or 4-in. stay laths, through-bolted to the piles of the bent. The top of the stay-laths is at a maximum elevation of 2 ft 6 in. above mean low water. Since the average tide change in the East River along the New York waterfront approximates 4½ ft from mean low water to mean high water, this maximum stay-lath elevation is approximately half the tide range, and is thus in conformity with Standard No. 87 of the National Fire Protection Association. This standard for the construction and protection of piers and wharves states (Chap. 3, paragraph 321(*a*), "Fire Resistant Substructures") that "Wood piles or wood cribwork . . . may be used . . . in tidal waters, if they do not extend more than one-half the tidal range or a maximum of three feet above low water."

The stay-lathing, which runs along both sides of each bent, supports the precast reinforced concrete cylinders or

"pipes," one of which is set over the top of each timber pile. However, the concrete cylinders do not rest directly on the stay-lathing, but each cylinder is set on a square of ½-in. asbestos cement plank which has previously been placed around the pile, directly on the stay-lathing. The plank is in two pieces, with a semicircle cut out of each piece, so that the two pieces fit tightly around the pile.

The cutoff elevation of the timber piles was specified to be 5 ft 4 in. above mean low water. The asbestos cement plank acts as the bottom form of the cylinder which rests on it. The cylinders have an inside diameter of 20 in. and a length of about 9 ft. A similar cylinder was placed over each of the batter piles that were driven midway between bents at each side of the pier. These piles were driven on a 3 to 1 batter.

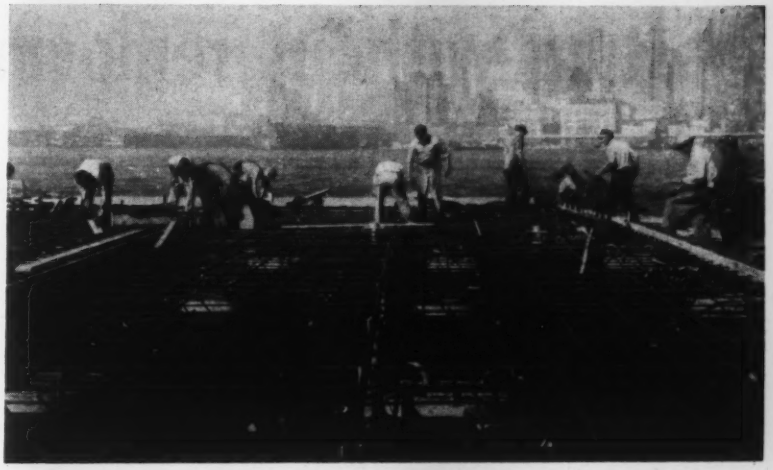
Four steel reinforcing rods were placed in each concrete cylinder, between it and the wood pile over which it had been set. These vertical No. 8 (1-in. round) rods extend down to within 2 or 3 in. of the asbestos cement plank and up 5 in. above the top lip of the cylinder. Here they are bent at right angles to extend horizontally into the deck slab. These rods were incorporated into the reinforcement assembly for the deck by spot welding them to the hooping. The hooping consists of No. 2 (¼-in.) spiral wire with a 6-in. pitch and a circle of 16½-in. diameter.

After the concrete cylinders had been placed, the deck-slab form was hung from their tops, so positioned that the top of the form was 4 in. below the lips of the cylinders. The deck-slab form may be of plywood or of corrugated sheet metal.

Next the reinforcing bars were placed for the deck. Then the deck, which is generally 12½ in. thick, was cast and at the same time the cylinders were filled with concrete so that the deck and the piles would form a monolithic whole.

These new deep-water Brooklyn piers prove that: (1) wood piles with long unsupported lengths are capable of carrying 20- and 25-ton design loads; (2) the design used provides a completely fireproof substructure without fire walls and deck nozzle holes; and (3) the resulting piers are fundamentally economical.

Grateful acknowledgement is due to the engineers of the Port of New York Authority, especially to John M. Kyle, Jr., F. ASCE, Chief Engineer, to A. Lyle King, Director of Marine Terminals, and to John S. Wilson, M. ASCE, Engineer of Design, under whose auspices these piers were planned and constructed.



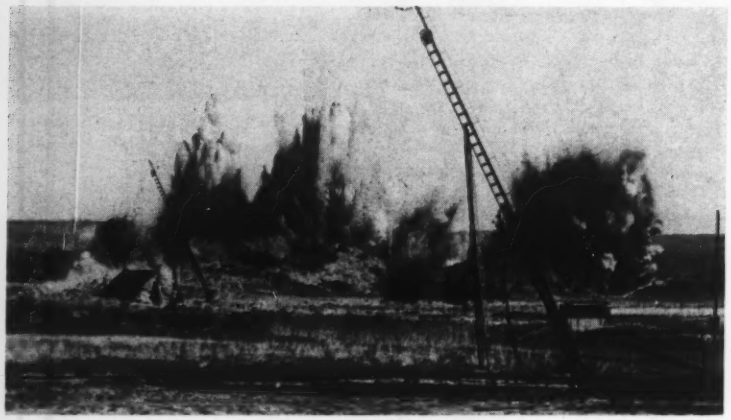
Deck reinforcing bars are being positioned in readiness for placing of concrete, which will tie deck and cylinders together in a monolithic structure.

Completed Pier No. 1 is seen from south end, with fender system in place. Note Brooklyn Bridge and downtown Manhattan in background. Close-up of fender system appears below.

Blasting without removing the overburden

STEN BRANNFORS, F. ASCE, Skanska Cementgjuteriet, Stockholm, Sweden

Fifty-six tons of dynamite in 4,750 bore holes broke up 36,000 cu yd of rock and lifted 90,000 cu yd of overburden. In about one-thousandth of a second, current applied through 300 miles of connecting wire had started the delay elements burning in 12,500 blasting caps.



A new method of drilling and blasting rock without removing the overlying soil layers, developed in Sweden by the firm of AB Skanska Cementgjuteriet, is currently being employed on a canal project. The first series of blasts culminated recently in the successful firing of a blast of 4,750 holes.

The canal is to cut off a sharp bend in the Motala River between Braviken Fiord and the port of Norrkoping, about 90 miles southwest of Stockholm. The section now being excavated is about 2 miles long (the whole length is 4 miles), and the finished canal will have a depth of 31 ft and a width at the bottom of 180 ft.

The soilcap, or overburden, consists mainly of glacial drift lying on the bedrock, covered by a top layer of clay. Varying quantities of rock have to be blasted at about a dozen points along the length of the canal. Owing to the instability of the water-logged clay, it was decided to drill and fire the blasts without removing the earth cover, and to perform the whole excavation as a dredging operation.

For drilling, special rigs were built with a 52-ft feed. The rock drill is an Atlas Copco BBC 43 machine with a special device substituted for the regular rotation mechanism, giving considerably greater torque. This device rotates both the drill pipe and the 1¼-in. drill-steel running through the pipe. The hammer blows are likewise transmitted both to the pipe and to the drill steel.

The pipe and drill steel are sunk simultaneously through the overburden with powerful jetting. When the end of the pipe has moved down about 6 in. into the bedrock, the pipe is uncoupled from the drill, and the hole is drilled to full depth in the usual manner by the drill steel alone. The steel is then withdrawn, leaving the pipe as a lining in the earth section of the hole. Next, plastic piping is pushed down inside the drill pipe and made to plug into the collar of the hole by a simple external packing ring. The steel pipe is then pulled up.

The actual loading is done with a compressed-air apparatus developed by the explosives manufacturers, Nitroglycerin AB. This apparatus consists of a plastic loading tube fitted with a breech opening that automatically closes when the compressed air is applied through a foot-operated valve. Except at the ejection end, where there is a narrower mouthpiece to build up pressure and slit the cartridge wrapping, the loading tube has an internal diameter slightly larger than the 24-mm (1 in.) diam. of the dynamite cartridges. Some 40 to 50 cartridges can be loaded at a time. Effective tamping action to give the required density of charge is obtained by an up-and-down movement of the loading tube in the bore hole.

After a few ordinary cartridges have been loaded and well tamped, the loading tube is withdrawn from the hole and a primer inserted in the mouthpiece. The priming charges, consisting of 22-mm cartridges of blasting gelatine with two short-delay electric detonators, are thus placed near the bottom of the holes. The tube is then pushed down into the hole with the detonator leg wires on the outside.

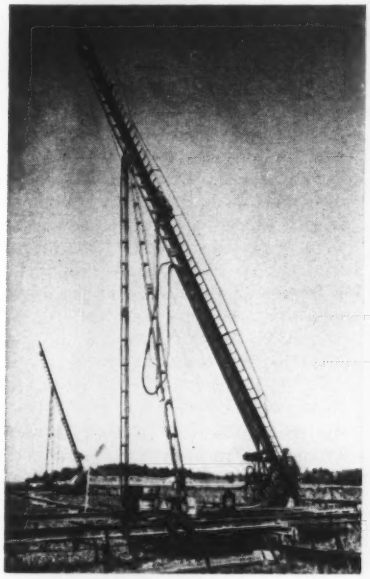
Where the rock section is especially deep, primers are also placed in the middle of the bore hole and near the collar. Thus for the recent 4,750-hole blast, more than 12,000 detonators were used to set off 123,000 lb of dynamite. The quantity of rock blasted was 36,000 cu yd, together with 90,000 cu yd of clay and moraine overlying it.

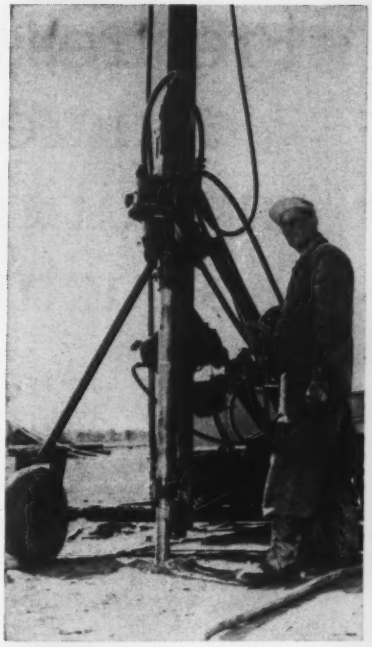
The large quantity of dynamite per cubic yard of rock is necessary to ensure adequate fragmentation for the subsequent dredging operation. The necessary concentration of explosive is achieved through considerably closer spacing of the holes than would normally be employed—about 5 ft instead of 7.5 ft.

This in turn poses the problem of preventing a disturbance of the firing sequence by propagation. It was solved by first loading every other hole with 60-percent dynamite, and then going over the blast area again, using charges of 50-percent dynamite for the holes in between. In the wet holes, the sensitiveness of the 60-percent dynamite becomes somewhat reduced, although its explosive force remains unimpaired. And as the weaker explosive is in the hole for a shorter length of time, its water-resisting properties are quite adequate. Loading and hooking up the blast took altogether about six weeks.

The number of intervals employed

Drill tower used on the Lindo Canal project is moved transversely and longitudinally over the drilling area by means of I-beam frames and tracks of steel sheetpiling. The drills, Atlas Copco BBC 43 drifter machines, are fitted with a special rotating mechanism and are served by three Atlas Copco compressors.





A wagon-mounted Lindo drill is seen boring through soil. Projecting part immediately above the pipe is the special mechanism for rotating the pipe and the drill steel inside of it.

Dynamite cartridge is being inserted in breech of compressed-air loader. Cartridges are pushed in until they begin to stick, then eased down the tube by release of some air. When forty or fifty cartridges have been inserted, compressed air is applied at 44 psi to force them into the hole.

for the big blast was 31, with delays varying from 12 to 13 milliseconds between the first 20 numbers, to from 25 to 100 milliseconds for the remainder. The holes were connected in 263 parallel series of about 45 holes each. Four twin-wire bus wires of bare copper, which ran the length of the blast area, were hung on posts and were in turn parallel-connected by cross leads. Connection with the blasting machine was by 500-m leading wires with a cross-sectional area of 50 sq mm.

A specially constructed blasting machine of the condenser-discharge type is used, power being supplied from a hand-driven generator. At 1,000 volts the capacity of the machine is about 1,000 amperes and the maximum output is about 1,000 kilowatts. In addition to the regular testing of the circuit and individual blasting caps for resistance, the leg wires of each cap are tested as soon as it has been inserted in the hole by means of a locally developed instrument for detecting the galvanic potentials arising from faulty insulation. The complete electrical circuit consisted of about 300 miles of wire. The loading and firing procedure has been developed throughout in close collaboration with experts of the Nitroglycerin AB company.

Previously some 120,000 cu yd of rock had been broken in smaller blasts, using 20,000 to 45,000 lb of dynamite per blast. The blast described here was to break the remainder of the 157,000-cu yd section of rock at the entrance to the canal. Subsequent rock sections will all be smaller.

In sections where the average hole is 40 ft deep (23 ft of clay, 7 ft of moraine, and 10 ft of rock), the drilling rate has been 15 holes per shift. The annular cutting head of the drill pipe is fitted with carbide teeth, and the drill rod is tipped with a 2-in. detachable 4-point bit with Coramant inserts.

Drilling through boulders

With the equipment employed on the Lindo canal projects, holes up to 65 ft deep can be drilled through difficult moraine containing large boulders. With more powerful equipment, the hole depth could obviously be increased. In addition to its use for blasting, the Lindo drilling method has been employed to drill anchorages for piles in sloping rock, the ability of the annular cutting head to start a hole in such circumstances being thus used to advantage. The method has also been employed in connection with underpinning and other reinforcement work, on account of the possibilities it gives for drilling economically through gravel, boulders, timber, and other obstructions. With pipe of larger diameter, sampling equipment can be put down inside it to obtain soil samples. The method itself is patented.

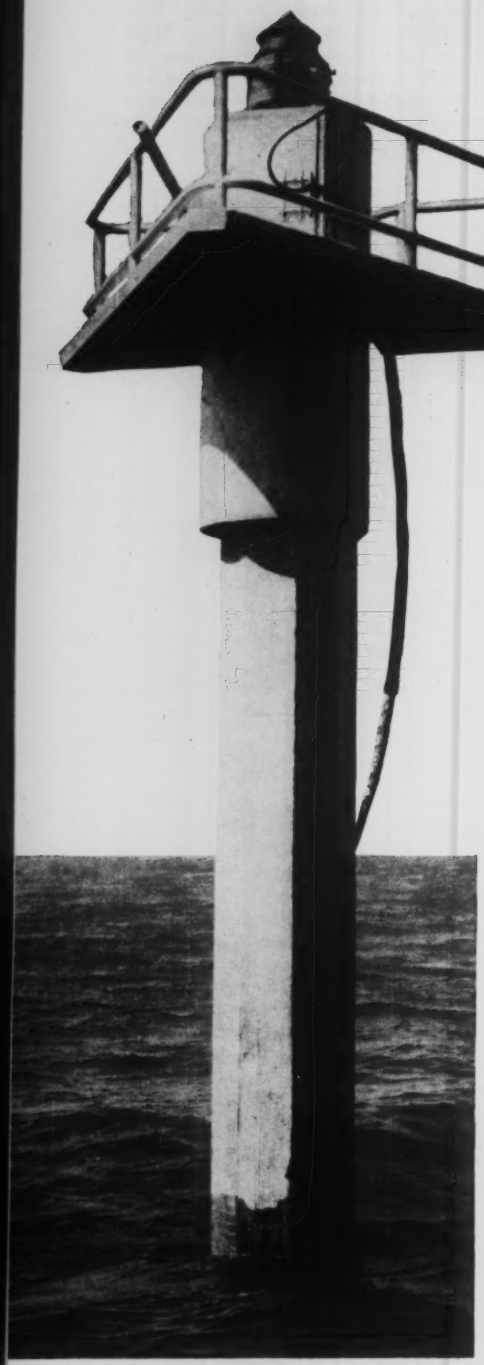
Dredging trials that were carried out at Norrkoping showed the fragmentation to be completely satisfactory. A new ladder dredge built for Skanska Cementgjuteriet has 0.8-cu yd buckets and a capacity of about 600 cu yd per hour when dredging loose material. Blasting will take place successively along the canal as the dredge moves forward. In addition to the dredging in the canal, a channel extending about 2 miles out into the fiord will have to be deepened. In all, about 5 million cu yd, including 260,000 cu yd of rock, will be dumped further out in the fiord.

It is interesting to compare the canal's bottom width of 180 ft with the 145-ft bottom width of the Kiel Canal and the 120-ft bottom width of the Manchester Ship Canal. Vessels up to 5,000 tons deadweight will be able to pass each other in the Lindo Canal. With one-way traffic, the depth of 31 ft will enable tankers of up to 16,000 tons to steam fully loaded right into Norrkoping.

Prestressed concrete in marine structures

BEN C. GERWICK, Jr., F. ASCE

President, Ben C. Gerwick, Inc., San Francisco, Calif.



Navigational light standard placed by U. S. Coast Guard in San Francisco Bay consists of a 20-in. octagonal pretensioned pile supporting a precast platform and a separate battery box.

For marine structures, there has been a rather spectacular increase in the use of prestressed concrete. It is rapidly gaining acceptance throughout the world as the foremost material for wharves, piers, and a host of minor but important structures exposed to sea water. This wide acceptance and utilization are based primarily on its excellent structural properties for such purposes, its durability, and its overall economy.

Pretensioned bearing and batter piles can be economically employed in almost any major harbor project anywhere in the world. They are chosen for durability, ability to withstand hard driving, strength as a long column, ease in handling, ability to take lateral bending, and economy. Varying degrees of prestress have been employed, but a standard seems to be the development of a minimum precompression of 700 psi in the concrete. Where bending stresses control, higher prestress may be used, up to a maximum of about 1,200 psi.

Pile sizes range from 12 in. and even smaller for octagonal cross sections, up to 54 in. for round or 36 in. for square. As a general rule, piles of normal length up to 20 in. or 24 in. are more economical if made solid. For long piles of 20 to 24 in. in diameter, and for sizes above 24 in. in diameter, a hollow core is justified. Allowable loads on individual piles depend mostly on the soil and the driving technique but capacities up to 900 psi are quite frequently used.

Pretensioned sheetpiles are extensively employed where durability and appearance are of major importance. Thus these piles are selected for sea walls or marinas, or for locations where exposure conditions are severe, such as in the Persian Gulf. In general, pretensioned sheetpiles cannot quite compete in economy with steel sheetpiles where no protective coatings are necessary and where high reverse bending stresses must be resisted. Eccentric prestressing has been successfully employed, but minimum and maximum acceptable prestress values depend on driving conditions.

Prestressed deck slabs are being more and more widely used as economy forces the use of longer spans. The slabs can be effectively tied together transversely by means of post-tensioning to make them act as a lateral girder in the plane of the deck. An alternative method is to use half-depth pretensioned bottom slabs with a poured-in-place top slab.

Prestressed fender and dolphin piles are relatively new. Performance to date has exceeded expectations but there are as yet no long-time records. Such piles should be designed to deflect as much as possible under load. Because of the repeated loadings expected, the design tensile stress in the concrete has been limited to about half the modulus of rupture to prevent cracking.

Minor marine structures

The special qualifications of prestressed concrete have led to the use of this material for a number of specialized marine structures. Some of these are of relatively minor importance as individual structures but of great importance in the aggregate.

Navigational light standards built by

the U.S. Coast Guard have traditionally been of treated timber piles and timber, constructed to the highest standards of workmanship and appearance. Increasing costs and the susceptibility to damage have led to the development and use in San Francisco Bay of a completely precast, prestressed, standardized structure. A single prestressed pile of lightweight concrete, 20 in. in diameter, with a hollow core, is driven and jetted to grade. On this are set and joined three precast units, manufactured with white cement, and prefitted with anodized aluminum ladders and fittings. These have an excellent appearance; they are structurally strong and easily installed. Their use is increasing and performance to date has been more than satisfactory.

Dolphins and mooring platforms have long presented a problem to the designer and have been costly to maintain. Their basic purpose is to resist sudden heavy lateral forces, often accompanied by shock loading. Although widely used in the past, timber structures have not proved entirely satisfactory, because it is difficult to connect the many elements so that they all work together. Steel-pile dolphins, capped with concrete, are an improvement but they are expensive; the compression flanges of H-piles tend to buckle, and there is often a maintenance problem. Prestressed piles, which work well in bending and tension, have recently been successfully used in a number of dolphins and mooring platforms. After the piles are driven, precast cap or deck units are set over them and the sockets are filled with cast-in-place concrete to tie the entire structure together.

In marine construction, some applications are subject to numerous reversals of bending in service. Under-deck fire walls are an example; here the wave forces often cause reversal of stress. Prestressed, precast firewalls are well adapted to this use because the concrete remains permanently crack-free under normal service. Units are set over or alongside of prestressed piles and the sockets are filled with concrete. They can also be hung from the deck as cantilevers, if properly designed and connected to the deck.

Many marine structures require catwalks and walkways. Timber has frequently been used for these in the past, but it requires considerable maintenance as the light framing employed is subject to damage by waves and boats. More recently steel has been used, with long spans, but it is costly and expensive to maintain. Prestressed concrete appears to be an ideal solution to this problem. The walk can be designed as a wide structural channel, with the flanges of the channel serving as rails and the web serving as walkway. Spans up to 100 ft or more can be used. Because there are usually only a few of these walkways and because of their length and weight, it may be found most economical to post-tension them. A typical design would provide for support at the quarter points, consisting of two-pile bents, thus utilizing continuity.

Octagonal piles driven for U.S. Navy Pier at Long Beach, Calif., are 16-in., precast and pretensioned.

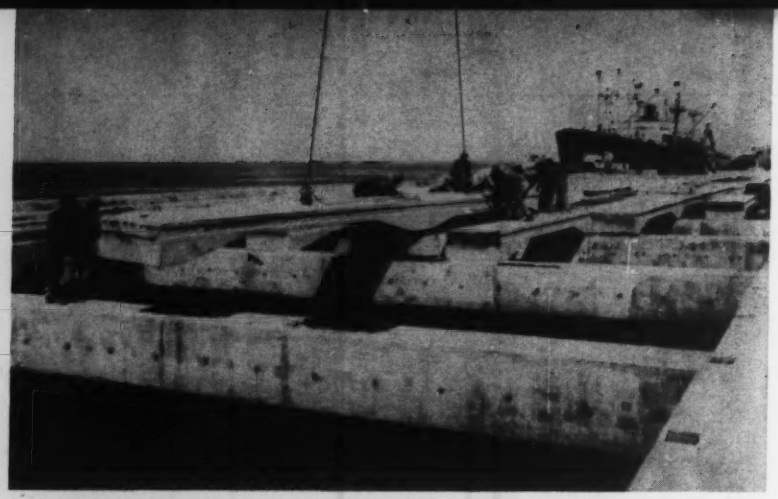
Any structural material has definite limitations; certain precautions must be exercised to ensure economical use. Because prestressed concrete elements will withstand a certain amount of rough handling and abuse and, in the case of piles, hard driving, there has been a tendency to be careless. Troubles do develop, and all prestressed concrete is criticized. For example, prestressed piles up to a certain length can be handled with a single pickup point and can be dragged to the driver. But piles cannot be dumped off trucks down a steep embankment without suffering some damage.

In pile driving the large hammers currently employed to achieve high bearing capacity may cause difficulty. Unless a properly designed and cushioned driving head is used, the combined impact, torsion and tensile stresses sometimes result in circumferential cracks about a third to a half of the way down the pile from the head. If driving is continued with this improper equipment, additional cracks will appear, spalling will take place, and sudden rupture may result.

This impact-torsion may be imparted by a tight-fitting driving head resisting a pile that wants to twist, or just by a hammer hitting eccentrically on one side of the head. With a hammer that is supported by lines or swinging leads, it may be the hammer that has a tendency to twist. The tensile stresses are due to the rebound of the wave produced in the pile by the hammer blow and are most severe in easy driving, often under the first few blows.

The general solution of this problem

Pretensioned piles provide moorings for naval craft at Long Beach, Calif. Note pretensioned sheetpiles along waterfront at far right. Guy F. Atkinson Co. was general contractor.



Deck slabs 48 ft long are continuous over one pile bent for wharf at Kuwait on the Persian Gulf. Gerwick did the design and manufacturing of the prestressed concrete elements for the prime contractors.

is to use ample thicknesses of softwood cushion blocks and provide ample clearance in the pile head. The "cushion blocks" referred to are those between the driving head and the pile. Blocks can be made up of 1-in. layers of softwood, such as Southern pine or Douglas fir, in thicknesses up to ten laminations, although four laminations are often sufficient for normal driving. These blocks provide the maximum energy absorption under the first few blows on the pile, but become compressed and thus transmit a maximum of energy to the pile during the final blows. Thick cushioning blocks also minimize torsion stresses. A more expensive way to meet the problem is to increase the amount of prestress; another is to reduce the energy delivered by the hammer during the early phases of driving.

It is important to note that this problem is common to all types of concrete piles, not just prestressed ones, and occurs more often as larger hammers are used to drive larger piles. A fuller description of this phenomenon was given by the writer in the *Journal* of the Prestressed Concrete Institute for June 1959.

Another problem occasionally encountered with hollow-core piles, such as thin-walled cylinder piles, is vertical cracks extending a few feet down from the head. This appears to be a simple splitting, due to lateral expansion under the blow. It can be solved by: (1) providing more spirals at the head, (2) using a solid section at the head, (3) using better cushion blocks, and (4) insuring that the surface of the pile head is in a plane perpendicular to the pile axis. On hollow-core piles with a solid head and open tip, vents should be provided just below the solid head to prevent splitting due to the hydraulic-ram effect in semi-fluid soils.

The highly vibrated concrete of low water-cement ratio that is used for prestressed concrete inherently produces some surface water bubbles and pockets on the return (overhanging) surface of the forms and, to a lesser extent, on vertical forms. These surface flaws are more apparent with steel or other impermeable-type forms used in mass production. Good form compounds, properly applied, and adequate vibration and rodding, will reduce the size of these defects to acceptable limits. Absorbent form liners will produce an almost perfect surface, but some of the bubbles will then be found hidden 1/16 in. or 1/8 in. below the surface. Such liners are quite costly. Vacuum treatment will eliminate the problem but is usually prohibitively expensive.

Good workmanship will produce acceptable surfaces. Where an architectural finish is required, it can be obtained, as with other concrete, by burlap rubbing and finishing after production. With some production processes, it may be practicable to strip the overhanging surfaces after initial set but before steam curing, and to finish the surface at that time. For structural reasons, in a corrosive marine environment, pockets should not be more than 1/4 in. deep. An occasional deeper pocket is not cause for rejection but must be properly dry-packed, with thorough soaking of the adjacent concrete before, and proper curing afterwards. Honeycombing and rock pockets are cause for rejection unless they are very small, in which case they must be chipped out, undercut, and properly dry-packed.

Plastic shortening of long horizontal beams (as in a pipeway), or a series of shorter beams and slabs, can sometimes cause troubles at the joints, and induce undesirable tensile stresses. The concrete, always under prestress but normally under only partial live load, tends to creep by plastic flow. With the thick members used in marine structures, there is less tendency to camber upwards than in thin roof slabs for example, but shortening does occur.

Shortening can be reduced to acceptable limits by using high-strength concrete, by avoiding excessive prestress in the concrete, and by adequate curing of concrete prior to installation. Since much of the total plastic flow occurs in the first month or so, storage of critical members for a period of time before installation may be desirable. Connections can be properly designed to distribute the shortening stresses and to control cracking just as is done with conventional concrete subject to expansion and contraction.

Consideration must be given to the stresses induced in the handling of prestressed units. Occasionally a girder designed as a simple beam is picked up or supported at the center. This develops tensile cracks due to negative moment over the center. In general, it is best to pick up and support such a unit at locations near the designed support or bearing points.

Wharves represent the largest general group of marine structures and it is here that the advantages of precast prestressed concrete appear to combine most favorably. The requirements of

For wharf at Kuwait on the Persian Gulf, sheetpiles are being installed at right, deck slabs in background. Project is being built by J. H. Pomeroy & Co., Inc., and Hawaiian Dredging Co., Inc.

long life (durability), strength in lateral bending, long unsupported columns in deep water, and the repetition of structural elements and relative standardization of loads, are inherent requirements in waterfront structures and make the precast prestressed concrete elements most desirable.

Problems remain in connecting piles to caps. Work has been done in this area, especially with socketed connections. The use of epoxy bonding agents and post-tensioning appears promising. Welding of embedded plates, later covered by grout, is another means that shows promise.

The use of prestressed deck slabs is not always economical. The saving in the deck slab proper is often offset by the inability to incorporate the deck slab as part of the cap. Further development is needed here. One solution is to pour first, in place, the lower half of the cap, on which the deck slab is set. Then the upper part of the cap is poured, and the whole cap is post-tensioned.

Use of lightweight prestressed concrete in marine structures is limited despite its extensive use in buildings. With the proper type of lightweight aggregate, excellent durability in sea water can be obtained. However, it appears most desirable to use some natural sand in the mix. With all lightweight fines, the modulus of elasticity is very low, with consequent deflection. The plastic flow may be greater with some aggregates. The use of natural sand helps to counteract this. There are specific uses of prestressed concrete where a lightweight material may be economical or otherwise desirable. The submerged weight of lightweight concrete is about half that of conventional sand-and-gravel concrete. A number of pretensioned lightweight piles have been driven, both in tests and in permanent structures, and they appear to withstand driving satisfactorily.

Splicing of piles, when necessary because of extreme length or an unexpected variation in length, is a field in which good progress is being made. Where it is known in advance that splices will be required, so that the piles can be designed accordingly, the solution is simpler. Most methods being studied today involve the use of a bonding compound (epoxy or other) which develops full strength within a short period, in combination with dowels or post-tensioning. The durability requirements may well affect the choice of bonding compound.

Prestressed splices require post-tensioning. In England this has been successfully done by using alloy bars, coupled together as sections are spliced on. A non-prestressed splice is much simpler and cheaper, where reinforcing steel dowels from the top section are set into holes drilled in the previously driven bottom section. The holes are filled with the bonding compound or with grout before the top section is set. Tests so far have been very satisfactory. Welding of steel sections embedded in top and bottom, covered with grout or special compound, has been successfully performed.

Research is urgently needed to determine the minimum concrete cover required over prestressed strands for durability in sea water. Obviously proper protection must be provided for the strands, since corrosion will proceed rapidly and produce real loss of strength if protection is inadequate. The effect of small water or air pockets in the surface of the concrete must be considered. European practice in general requires less cover for sea-water exposure than American practice. Russian engineers recommend a cover thickness of 1½ in. to 2 in., as do the French.

American practice for piling almost universally requires a 2-in. cover. However, a 2½-in. cover has been used in Los Angeles Harbor and some other areas, where past experience with reinforced concrete has been unsatisfactory. The change from a 2-in. to a 2½-in. cover for piling involves no change in elastic behavior (up to cracking) and a loss of only about 5 percent in ultimate strength. For piling, there is no change in cost either, as long as one standard is used without change.

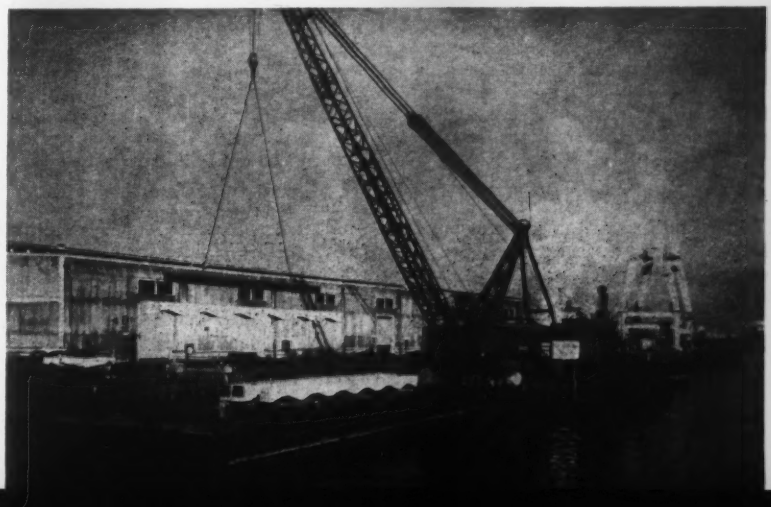
In beams, girders and slabs, an increase in the thickness of the concrete cover causes a very marked increase in cost. The 2-in. cover is believed to be conservative and proper for most American harbor structures. This is a subject for further research, to be followed by standardization.

All hands turned out to watch docking of first ship at Kuwait alongside pier equipped with pretensioned fender piles. Note circular rubber bumpers.

Prestressed concrete has made a spectacular entry into the field of marine structures. Continued development, research, and experience are needed to achieve the fullest, most effective, and most economical use of this material. With continued imaginative effort it will be possible to use prestressed concrete for an ever-increasing number of marine structures with resulting economic, esthetic and structural advantages.

(This article was presented by Mr. Gerwick as a paper at the ASCE Annual Convention in Washington, D. C., before the session of the Committee on Ports and Harbors of the Waterways and Harbors Division, presided over by Lawrence B. Feagin, Chairman of the Division's Executive Committee.)

Six-span continuous prestressed concrete girder is placed in existing timber dock at Alameda, Calif. Girders are supported on prestressed piles driven through deck, and will support large crane seen in background.



EPOXY ADHESIVES in concrete construction

R. W. GAUL and A. J. APTON

Adhesive Engineering Division of Hiller Aircraft Corporation, San Carlos, Calif.

Epoxy adhesives have been used on both concrete and asphalt surfaces, to bond new concrete to old, to bond precast concrete sections, to anchor traffic bars to road surfaces, to level chuck holes, to fill cracks, spalls and depressions, to bond traffic buttons to the roadway surface, and to bond steel dowels into concrete pavement. In fact, for the past five years adhesives with an epoxy resin base, in liquid, paste and grout forms, have been undergoing tests as bonding agents for concrete in highways, bridges, aircraft runways, buildings, streets, and sidewalks.

Results of the tests have been impressive. Epoxy adhesives have proved versatile and easy to use; they form bonds that are actually stronger than the concrete itself. Costs for materials and labor frequently are less than half those of conventional repair methods. In many cases the use of these adhesives will speed repairs so that traffic can move over a repaired area in about three hours.

Strength evaluated

Epoxy adhesives for concrete bonding have been specially developed to ensure high flexural, tensile and shear strengths, good impact and environmental resistance and some degree of flexibility. The effective strength of the adhesive is the actual strength of the concrete since the strength of the adhesive and its bond are substantially higher than the cohesive strength of the concrete mass. Fully-set tensile strength varies from 200 to 700 psi, according to the concrete mix. Flexural strength for either cross-bonded or laminated beams is in the same range. The effective shear strength of an epoxy adhesive joint is 4,000 to 5,000 psi.

The effective impact strength of an epoxy bond is that of the entire concrete mass, even when the bonded layer is thin or feather edged. Epoxy joints resist environmental forces commonly encountered by concrete roadways and structures. In addition to being impervious to water, gasoline, fuels, lubricating oils, most hydrocarbon solvents and de-icing salts, they can withstand freeze-thaw cycles and temperatures from minus 70 deg F to well over plus 350 deg F.

While the adhesives are thermosetting and therefore rigid by comparison with rubbers and flexible plastics, they are designed to have an important degree of flexibility which allows them to withstand shrinkage strains resulting from concrete curing. In most normal applications, they will accommodate thermal expansion and contraction throughout the entire temperature range to which concrete structures are generally exposed.

It should be made clear that while epoxy resins have been saddled with the term "miracle plastics," there are many different types, each designed for specific applications. No single resin will meet all engineering requirements. For example, to produce epoxy adhesives with the most desirable properties for concrete bonding, three different resins—Epon(R) 815, 820 and 828—are combined with polysulfide resins and selected amine hardeners. (Epon is a trade name of the Shell Chemical Corp.) The resulting three products are Concresive 1, a low-viscosity fluid that can be readily applied by brush or can be sprayed with special equipment; Concresive 2, a paste that is preferable for bonding two rigid materials together since it will fill voids between the surfaces if they do not meet perfectly; and Concresive 3, a grouting compound that is less viscous than Concresive 2 and is designed for bonding shapes such as dowels in concrete structures.

Adhesives are supplied in two parts consisting of resin and hardener. These are mixed together before use and produce the bond as they cure through chemical reaction. Therefore, to avoid waste, only as much of the adhesive should be prepared as can be applied before the resin sets, usually in 30 minutes to one hour.

Surfaces to be bonded must be free of contaminants. The degree of preparation required to expose clean concrete will depend on age, previous use, and exposure. Concrete impregnated with oil or grease should be sandblasted, or etched with a diluted acid solution. After acid etching, surfaces should be flushed with water to remove residues and thoroughly dried before the adhesive is applied. For ordinary sidewalk repairs, wire brushing followed by a blast of compressed air to blow away dirt and dust is usually sufficient.

New concrete applied over the epoxy adhesive should always be a relatively dry mix, with a standard slump of zero to 2½ in. Coarse aggregate can be used except on feather edges. For a smooth outer surface, dry-mix concrete can be covered with a wetter surfacing mix.

Repair of sidewalks and gutters

In areas subject to much settling, such as in gutters where true grade cannot be met by original concrete casting, or in sidewalks that have settled to the point where they are hazards, the epoxy adhesive is brushed on just before a fresh concrete grout is overlaid. This method serves to build up gutter grade to the proper levels and eliminates "bird baths" and de-

Depressed gutter area is raised to proper level by troweling sand and cement mortar over surface coated with epoxy adhesive.

Half of steel dowel 24 in. long is coated with epoxy grouting compound before dowel is inserted into precoated hole in aircraft runway at Mather Air Force Base.

pressions. Naturally, any slab that is overlaid should be structurally sound. If the gutter is too high, the surface can be chipped down just below the desired level and then built up to a smooth surface at the desired level by bonding the new surfacing concrete to the old. When concrete is feathered, it is especially desirable to use a curing compound to prevent too rapid drying.

Small cracks are sealed by either pouring or brushing the adhesive in. For wide cracks, the adhesive is mixed with clean, dry sand and troweled on like a mortar. The strength and the slightly flexible nature of the bonding agent are sufficient to resist load and temperature stresses, and to prevent progressive concrete failure that might otherwise occur at cracks.

One of the major advantages of the epoxy binding process in this type of repair is the total saving realized. The cost of repairing a concrete sidewalk by overlaying will be at least 50 percent less than the cost of replacement with new concrete. In most cases, repairs by bonding an overlay of concrete to a sidewalk depression will range between 30 and 50 cents per sq ft for areas under 100 sq ft. By comparison, to tear out a similar area and replace it with a fresh pour would cost from 80 cents to $1.00 per sq ft.

At 80 deg F or slightly lower, the adhesive, when applied in a thin layer over the old concrete, will remain in a tacky condition that will permit bonding with the new concrete for 45 minutes. At 110 deg F, the setting time is reduced to 30 minutes. When pavement temperatures rise to 150 deg F (not uncommon in desert localities), the setting time of the adhesive drops

Crack in roadway of viaduct near San Mateo, Calif., was filled with epoxy adhesive over two years ago, when other repair methods had failed.

After more than five years of service on a busy street, these cast epoxy traffic buttons, bonded to the surface with an epoxy adhesive, are still in place and show few signs of wear.

Two ribbons of liquid adhesive are brushed onto plant-mix road surface just before concrete curb is extruded. Curbing was laid by J. S. Mattos Concrete Co., Hayward, Calif.

Substantial savings in time and labor are realized by concrete curb extrusion method. Concrete and adhesive cure simultaneously producing an almost indestructible bond.

to about 5 minutes. Since it would be difficult to pour concrete in this time, in these areas such work is usually scheduled for the morning hours.

Repair of chuck holes

For street repairs the requirements in an epoxy resin adhesive are high strength and a certain degree of flexibility so that the repair material will give with the pavement. This type of material has been used with much success to repair chuck holes, pot holes and deep cracks in both asphalt and concrete pavements. Crushed granite and sand are added to the liquid adhesive to produce a grout-like material, which can be troweled easily to the desired level. In cases where a road must be opened to traffic with a minimum of delay, the repairing compound can be cured in less than 30 minutes by the application of heat.

On several heavily traveled streets in the City of Los Altos, Calif., chuck holes were repaired in this way in July 1958. A recent examination of several of the repaired sections revealed that the adhsive compound was still intact, without any signs of cracking or breaking, and that the color of the pigmented bonding material matched the road so well that some of the repair patches could not be located.

Bonding extruded dividers

The technique of bonding continuously extruded concrete curb to existing roadways is still quite new. To date, only the State of California has issued contracts for such curbs, primarily for dividing strips on both asphalt and concrete pavements. A traffic island 4 miles long was recently completed on El Camino Real between Sunnyvale and Santa Clara, Calif. Construction of this island required a total of 8 miles of the extruded concrete, the two curbs being placed 8 ft apart, parallel to each other and to the roadway.

The prime advantage of extruded curbing is that it costs less than half that of conventionally cast curbs. Since the only concrete needed is above the roadway, the total amount of concrete is sharply reduced. Sizable labor savings are also realized by eliminating excavation and the setting up of forms. The average national and California cost of installing standard poured curbing is about $2.50 per lin ft—which might drop to $2.00 on long-run jobs. However, if the curbing is extruded in a continuous ribbon, which is bonded permanently to the roadway, the total cost of labor and materials will drop to less than $1.00 per lin ft.

This curbing consists of fresh, dry and almost no-slump concrete extruded in final form by special machines. (One type is made by E. L. Hardin Associates, Salisbury, N. C.) This method of on-the-job application eliminates the labor of pouring individual curb sections plus the problems of storing and later transporting the sections to the job site. Bonding the still-wet concrete to the roadway with the adhesive assures permanent anchoring of the curb despite impact by car and truck wheels.

Immediately before the concrete is extruded onto the pavement the adhesive is brushed onto the roadway surface in two strips each 1 in. wide. These are placed along the edges of the strip on to which the 10-in.-wider curb will be extruded. The adhesive is designed with a curing rate such that, once applied, there is more than enough time for the curb to be laid.

In this application curing time for the adhesive is not regarded as a critical factor because the resin will cure more rapidly and develop strength faster than will the concrete.

Epoxy traffic buttons

Over two years ago, traffic buttons cast from epoxy resin were designed for use as lane dividers on the Richmond-San Raphael Bridge, which crosses the northern arm of San Francisco Bay. These buttons were made of a tough epoxy resin casting compound to the specifications of the California State Division of Highways. They were then bonded to the road surface with an epoxy adhesive. Despite continuous traffic of all types, they have not been damaged nor have they worked loose.

At two locations in California, sets of experimental cast epoxy traffic buttons bonded to the roadway have a record of over five years of service. One is on Hanson Way in Palo Alto and the other on the San Francisco-Oakland Bay Bridge. Although the edges of these buttons now show some wear, the buttons themselves are still firmly attached to the road.

One of the problems created by the newest Air Force bombers is that their equipment loads expose certain runway areas to unusual stress. As one solution, the Corps of Engineers in 1957 specified increases in the pavement thickness plus the use of steel dowels to connect adjacent pavement strips for load transfer in these areas. One of the first applications of the new method was on the heavy-duty pavement at Mather Air Force Base.

The design called for dowels of 20-in. and 24-in. lengths (depending on pavement thickness) to be spaced 18 in. on centers along the longitudinal construction joints. These dowels were to be of 2-in. extra-strong pipe (2.375-in. O.D.). Half the dowel length was to be cast in one concrete slab, while the other half was to be greased so that it would be free to move in the adjoining slab. However, because of the spacing and diameter of the dowels, it proved difficult to remove the forms over them.

Anchoring runway dowels

The contractor solved the problem by casting holes in the edge of the pavement slab to receive the dowels. Plastic dummy dowels were bolted to the inside of the forms and removed after the concrete had set and the forms had been removed. The holes were made slightly larger than the dowel diameter.

To bond the dowels tightly into the holes, a portland cement grout was first tried and found inadequate because it had not filled the space between the dowels and the precast holes.

A material therefore was sought that could be applied in a fluid state. It must possess sufficient viscosity to completely fill the space and not flow out from around the dowel. Yet it must provide adhesion between the dowel and the concrete of a strength at least equal to that of the adjacent concrete.

The need for permanent anchoring of the dowels prompted the engineers to employ an epoxy grouting compound whose adhesive strength had been proved suitable for bonding steel to concrete. Both the holes and half the length of the steel dowels were coated with the grouting compound and the dowels were then inserted into the holes. The compound was designed to set moderately hard in 24 to 48 hours at 75 deg F and to develop full strength in 6 to 8 days at this temperature.

Tests were performed by the Corps of Engineers for bond strength in shear between the concrete and the dowel. Dowels were bonded into concrete beams in the same manner as into the pavement. After the adhesive had cured, a section of the beam was sawed out. In each test the concrete was shattered without breaking the bond of the dowel to the concrete. As a result of these and other studies, this method of installing dowels has been approved for use in the Corps of Engineers Contract Specification for Rigid Pavement as an alternate method of construction.

This test work was accomplished by the Sacramento District, U.S. Army Corps of Engineers, under Col. A. E. McCollam, District Engineer. Technical assistance was provided by the Materials and Research Laboratory of the California State Division of Highways, which has had extensive experience in the use of epoxy adhesives.

ANCLE C. TESTER

Secretary-Treasurer, John Tester & Son, Inc.

General Contractors, Clinton, Md.

Competition in construction

The number of construction firms in the United States has increased 26 percent since 1951, faster than any other segment of business. Only finance, insurance and real estate have come close to this rate of expansion. Reports indicate that this will be a $60-billion construction year so there is work ahead for a lot of new people. But the competition for a part of the construction dollar is very keen.

In the face of increased construction activity, the biggest complaint from contractors across the nation is that they are continuing to meet competition, ranging from "stiff" to "cutthroat." They say the competition in many areas is so severe that bids are far below engineers' and architects' estimates. Further, this bid-price chopping is coming out of profit margins, despite higher costs of labor, materials and working capital.

Yet regardless of statements to the contrary, the construction industry is not going broke or falling apart. Success in the contracting business is not rare. Many men have achieved it; within construction you will find more individualistic, energetic and ambitious men than in any other field, bar none. No wonder then that it is so competitive. The higher up the ladder of success a company goes, the keener the competition. Underneath all this bickering and complaining is one of the smoothest and most efficient machines this country, or the world for that matter, has ever known.

Proof of this can be seen on any construction project. Look down into the excavation where men are moving about and you wonder if any one of them knows just what he is doing. But come back in a few weeks, and you will be amazed to find that concrete is being placed on the sixth floor, with aluminum sash and curtain-wall construction following right behind. More accurate design by the engineers, improved materials, modern machinery and the availability of skilled workmen, combined with experienced management, are reducing the completion time of many projects by days and even weeks.

This country came out of the war with its money supply inflated to nearly three times its former total and with a tremendous demand for civilian goods. Capital flowed back into the construction of factories, office buildings, apartments, churches, schools, and utilities. There is a continued demand for fabulous military hardware. And on top of all this came the massive highway program. It was natural that construction should expand. People from all walks of life, from bricklayers to grocery clerks, became contractors.

This expansion attracted material and equipment suppliers, real estate, insurance and bonding companies, and bankers, all competing for a part of the construction dollar.

Established firms started doing a larger volume of business than ever before. Because of their experience, they foresaw the rise in construction costs and were adding to their bids to take care of it. This allowed many newcomers to get a foothold in the industry. Projects of the sort that had previously attracted only 5 or 6 bidders, now were getting 10 to 15, or perhaps 20 bids. Many of these bids came from general contractors and subcontractors who were just starting out, with very little experience and little money.

Some of the newcomers entered the field with the idea, "What can I lose if I get the job? I will at least make more money this way than I would working for someone else." Since the surety companies, with their agents, were interested in obtaining a piece of the construction dollar, the new firms got completion and payment bonds. The subcontractors and material suppliers were happy to take a job just so long as the project had a bond. They knew they would be paid. Little thought was given to the owner, who was paying for the whole thing. If he did not like the way things were being done and complained, the builders would slow the job down on one pretext or another until he was in a spot and had to have the building at any cost.

Almost any project would be under construction for a year. Because of the number of jobs available, a contractor could obtain at least three, which if spread apart properly, would last three years. With unbalanced requisitions for partial payment, and the holding back of some of the money due to subcontractors, it would be nearly impossible to tell whether money was being made or lost. The embryo contractor couldn't even tell himself, since most bookkeeping used in construction is from one to three months behind in showing costs.

The knowledge that the contractor is in financial difficulties does not help much since the real damage is done when he submits his price for the work. Other bidders check their estimates to see how they could have cut their prices to meet his, or how he can possibly do the work for the amount bid and still make a profit. This is one of the pitfalls of construction. Many a time a contractor feels that if someone else can do a job for a certain price, he can too. This applies to subcontractors as well as to general contractors.

Many a subcontractor will take a job without being fully aware of his responsibility under the terms of the contract, or whether he can do the job for the amount of money stated in it. He takes the job because a competitor is after it at that figure, or so he is told by the general contractor. In the long run there may be some profit from this as occasionally a new construction idea is developed to meet the necessity of staying solvent.

One idea for trimming cost is to substitute other materials for those specified in the contract. There may be a big difference in the cost of the material and the labor of installation if an alternate material is used. It is believed that the architect and engineer can help by insisting that the specified material be used unless a change order is processed. Change orders cannot be permitted too generally or contractors will come to feel that they can get things changed by a formal order while giving much less credit for the saving than is equitable.

Construction operates as a free enterprise system. Any amateur can start a contracting business but it takes an alert hardworking and skillful manager to stay in it. He is the one who goes to his lawyer when he has a problem of law, and to his banker when he needs money. He consults with the most reputable dealers when considering the purchase of new equipment and plans his activities so as to have as much work as he can handle when he needs it. He regularly watches costs and makes prompt checkups on even minor items that get out of line. He adopts new ideas on taxes, insurance and labor as well as on field activities. In fact, most successful building contractors continuously review their companies' operations and procedures in search of better methods and the lowest possible overhead, both of which can be reflected in lower bids to the purchasing public.

In any event, we have the satisfaction of knowing that the kind of competition we are experiencing today is the kind that has resulted from good times—not bad. Our economy's great potential for future construction can be realized only if construction management continues to look ahead and continues to take risks. This is the contribution that construction can and must make to ensure dynamic growth. More than ever there is a challenge to future management, to those who are just starting their careers in construction, and to those who are still students.

(This article is based on the paper presented by Mr. Tester at the ASCE Annual Convention in Washington, D. C., before the Construction Division session presided over by Walter L. Couse, Chairman of the Division's Executive Committee.)

Mammoth box girder placed in Chicago tri-level grade separation

ROBERT H. DE GRANGE, M. ASCE, Editor, *"Chicago Public Works Engineer,"* Chicago, Ill.

Within sight of the skyscrapers of Chicago's Loop, a major tri-level grade separation is nearing completion. In this congested area between Kinzie and Hubbard Streets, many complex and intricate problems of design and construction had to be overcome, especially since a railroad is involved. At this point the Northwest Expressway will pass on a skew under Hubbard and Kinzie Streets on the second level, and under the Chicago and North Western Railroad on the top level. At the second level Green Street will be carried across the expressway parallel to the railroad. Because of the great depth between the high-level railroad crossing and the low-level expressway, foundation problems were difficult and a complex structural design was required.

In order to start this project, a temporary trestle was constructed in Hubbard Street to carry the Chicago and North Western Railroad trains during construction operations. The skew crossing of the Northwest Expressway under the railroad and the city streets, called for a long rail span capable of carrying heavy railroad loads. Two enormous steel girders, to form a box girder, were designed for this span. These girders will be the key elements in the steel structure that will support 10 tracks of the Chicago and North Western Railroad topping the three-level grade separation. One girder is 125 ft 11¼ in. long and weighs 184 tons; the second is 127 ft 3 in. long and weighs 193 tons. Each girder measures 13 ft 2 in. in depth.

Commissioner of Public Works, George DeMent and Chief Engineer Dick Van Gorp, F. ASCE, of Chicago's Bureau of Engineering, stated that to the best of their knowledge, these are the heaviest girders ever shipped by rail in one piece. They were fabricated by the American Bridge Div. of U.S. Steel Corp., in Ambridge, Pa., and were transported to Chicago by rail, each girder lashed to three flat cars. The girders were erected under the supervision of the U.S. Steel Corp.

Because of limited space between two sets of two Chicago and North Western commuter line tracks, it was necessary

to bring construction materials and equipment, as well as the two girders, through a maze of temporary trestles and supports. When in position on reinforced concrete columns, the two girders, joined to form a box girder, will support 60 smaller girders which in turn will support the railroad bed.

Bringing the girders into position created a difficult problem for American Bridge Div. engineers. Its solution required the construction of a special short section of railroad and the purchase of the largest crane available for construction work—a 125-ton Manitowoc. Transporting the girders to the Chicago site took some careful figuring.

Railroad regulations permitted the girders to be moved only at slow speed and during daylight hours. The engineers picked an unloading spot where there was plenty of room to maneuver the girders with cranes and trucks. Using two 60-ton construction cranes, the first girder was lifted, one end at a time, and placed on two multi-tiered lowboy trailers. Each trailer was tractor driven in tandem with the load. The tractors, one pulling and one backing, eased the girder around street corners at a snail's pace. When it arrived at the construction site, a special crane lifted one end from the first truck and placed it on a 100-ton railroad push car. A special short section of track had been built to carry the girder the final 200 ft through a railroad trestle to a point alongside the two reinforced concrete columns that were to support it after installation.

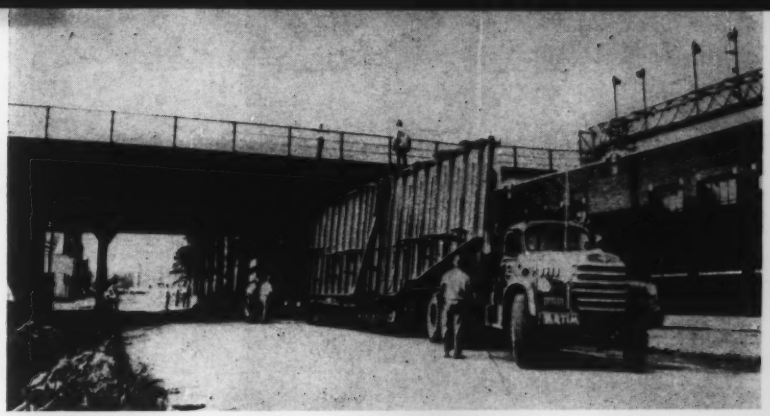
As the front end of the girder started into the tunnel through the trestle, the back end was swung on to a second push car. With only inches of clearance on each side, the girder was pulled at crawl speed by carefully controlled winches to a cleared area adjacent to the supporting columns.

Here one end was lifted by the big Manitowoc crane onto the steel shoe prepared for it on a reinforced concrete column. The other end was similarly mounted. One shoe, a 14-ton rocker, will permit the finished box girder to expand and contract slightly with temperature changes. The other shoe, weighing 17½ tons, is fixed rigidly to the column. As soon as this first girder was in position the procedure described was repeated for the second girder.

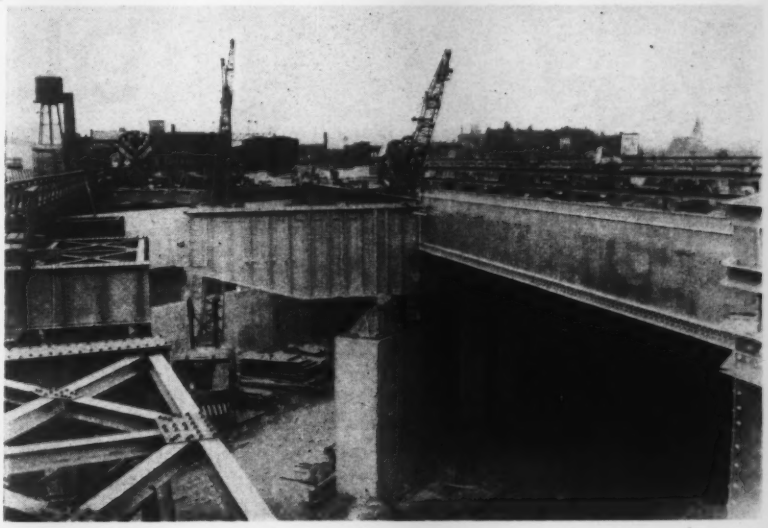
With both sections of the box girder in final position, the crews started immediately to erect on top of it the girders and braces that will directly support the railroad bed.

Steel erection for the overpass is scheduled for completion this winter.

Alfred Benesch and Associates of Chicago, structural engineers, were the designers.

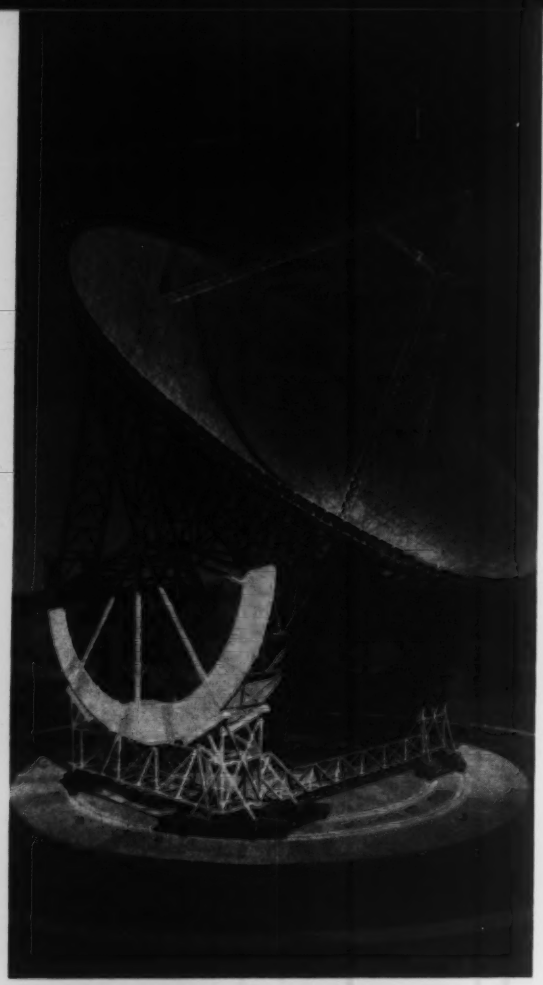


With two inches to spare, girder 13 ft high is eased through an underpass on route prepared in advance by American Bridge Co. engineers from railroad to site of tri-level grade separation in Chicago.



Box girders of record proportions supports ten tracks of Chicago and North Western Railroad. One end of girder extends beyond the rail structure proper to carry the ends of yard tracks to be constructed in background. At lower right foreground the northbound lane of the new Northwest Expressway (like the southbound lane at left) runs on a skew at the lowest level of the three-level grade separation structure.

Other end of the box girder also rests on a steel shoe on top of a reinforced concrete column.



THE BIG DISH

F. C. TYRRELL, F. ASCE, Captain, CEC, USN

Resident Officer in Charge of Construction

Naval Radio Research Station, Sugar Grove, W. Va.

Perhaps the world's largest movable land object is the radio telescope of 600-ft diameter under construction by the U.S. Navy at Sugar Grove, W. Va. Note the comparative size of vehicles and personnel.

The "Big Dish," a parabolic antenna of 600-ft diameter, is under construction near Sugar Grove, W. Va. This steerable radio telescope, being built for the Office of Naval Research, will be of unprecedented size and more complex than any similar equipment anywhere in the world. The antenna will be capable of altitude rotation from the horizon to the zenith while the entire structure will be able to rotate up to 450 deg in a horizontal plane. Its cost is expected to be approximately $79,000,000.

The largest similar device now in use is the radio telescope at Jodrell Bank, England, which is 250 ft in diameter. The Soviets may be building a unit of 350-ft diameter. The Naval Research Laboratory at Washington, D. C., already is operating instruments of 50, 60, and 84 ft in diameter. The National Science Foundation is sponsor for the construction of radio telescopes of 85- and 140-ft diameter at Greenbank, W. Va., 30 miles from the site of the Big Dish. A similar 85-ft telescope is in use at the University of Michigan under the sponsorship of the Office of Naval Research.

How was it possible to design and construct a steerable radio telescope nearly six times the size of the Jodrell Bank installation? The unit must have a very accurate antenna surface and be driven and controlled to precise aiming tolerances. The structural-steel frame is required to support an antenna with a diameter greater than the height of the Washington Monument and an area exposed to the wind of more than seven acres, greater than that of the Empire State Building.

The Naval Research Laboratory and the Bureau of Yards and Docks, U. S. Navy, developed the technical specifications for the telescope and its appurtenances, and the latter was given responsibility for engineering and construction. To conduct feasibility studies, the architect-engineer firms of Frank Grad & Sons of Newark, N. J.; Urbahn,

Brayton & Burrows of New York, N. Y.; and Seelye, Stevenson, Value & Knecht of New York, N. Y., were selected. This joint venture engaged the services of Battelle Memorial Institute of Columbus, Ohio, and numerous consultants for the project.

Work was started in September 1956. The architect-engineer contractor concluded that construction was feasible and recommended an alt-azimuth mount, with independent support and independent motions for the altitude and azimuth movements of the antenna. The solid-surface antenna originally planned resulted in high wind and ice loads. Two-wheel flotation, two-wheel non-flotation, and trunnion concepts were evaluated. Preliminary designs were developed in sufficient detail to permit comparison of such factors as the weight of the structural steel, various erection schemes, methods of control and movement, and total cost. As the result of these studies the two-wheel non-flotation design was selected.

The technical specifications for preliminary engineering and final design include specific live-load criteria, as follows:

Operating conditions:

1. Wind at 20 mph plus ice at 2½ psf
2. Wind at 30 mph and no ice

Non-operating conditions:

1. Wind at 50 mph plus ice at 5 psf
2. Wind at 90 mph and no ice

All wind loads include a 50-percent gust factor applied on any 10 percent of the total area of the antenna.

The velocity pressure of wind was taken as $q = 0.00256\ V^2$, where

q = velocity pressure, in psf
V = velocity of wind, in mph
h = height above ground level, in ft

For heights above 50 ft, velocity pressures are increased in accordance with the formula, $q_h = (h/50)^{2/7} q$

Allowable stresses for designing and detailing are in accordance with current specifications of the AISC, except that the non-operating allowable stresses are determined as follows:

1. For members governed by flexure or axial tension, 80 percent of the yield strength of the material.
2. For members governed by axial compression where elastic stability does not govern, 75 percent of the yield strength of the material.
3. For members governed by elastic stability, 70 percent of the critical strength.
4. For stresses such as shear, bearing, etc., the values used in design follow AISC specifications.

From the inception of the project the feasibility of providing a structural framework to support the antenna was one of the major problems. The method of framing the superstructure was not determined until comparative studies of the following systems had been completed: one-way truss, two-way truss, radial truss, ring girder, and space frame. The two-way truss system (Fig. 1) was finally selected as it provides greater stiffness and better distribution of loads.

The problem of designing a bracing system adequate to transfer a maximum horizontal wind-shear force of 12,700,000 lb through the structure to the pintle with a minimum lateral displacement was solved by providing a V-shaped fixed portal attached to the altitude wheels at the plane of the bottom chord of the superstructure truss system. The rotation of the wheels at the plane about the fixed portal and the transfer of horizontal load is through massive thrust bearings.

The two-way main-truss framing system and intricate bracing of the superstructure resulted in a high degree of redundancy which had to be analyzed so that the design would be adequate and economical. The IBM 704 computer has sufficient capacity to solve the problem; it is reported that this is the most complex single task attempted to date with this equipment. The two-way truss system has as many as thirteen major members meeting at a joint. The transfer of stress at these joints or weldments is through pairs of heavy gusset plates reinforced by diaphragms and stiffeners. Structural steel is shop welded, and high-strength bolts are used for all field connections.

The surface of the antenna is expanded aluminum mesh supported by aluminum purlins spaced at 10-in. centers. The purlins are welded to tubular aluminum welded trusses forming panel units about 55 ft on a side and 10 ft deep. Since deflection of the structural-steel supporting frame caused by wind, ice, and temperature changes will far exceed the allowable deviation of the antenna surface from a true parabolic shape, a system designated as "configuration control" was devised to support the antenna so that the true parabolic shape can be maintained.

The antenna panels are designed to be supported at the corners on reversible screw jacks. As the steel frame deflects under various loading conditions, the corner jacks are automatically adjusted to compensate for the deflection, thus permitting the antenna to maintain its true parabolic shape about its axis.

The superstructure is supported by two altitude wheels of 190-ft radius. Each altitude wheel consists of two dual-web box girders spaced 50 ft apart. Each box girder or rim, 3 ft 6 in. wide and 30 ft deep, supports two rectangular steel billets, 10 in. wide and 4½ in. thick, which serve as tires. Each tire, in turn, bears against 16 support-drive rollers of the altitude-drive system. Thus eight steel tires bearing against a total of 128 rollers support the total dead and live load of the antenna above the turntable, and at the same time provide for the 90-deg rotation of the antenna about the horizontal axis.

Two drive-support rollers are paired side by side in a total of 64 drive modules. The drive modules are designed to allow several degrees of movement to

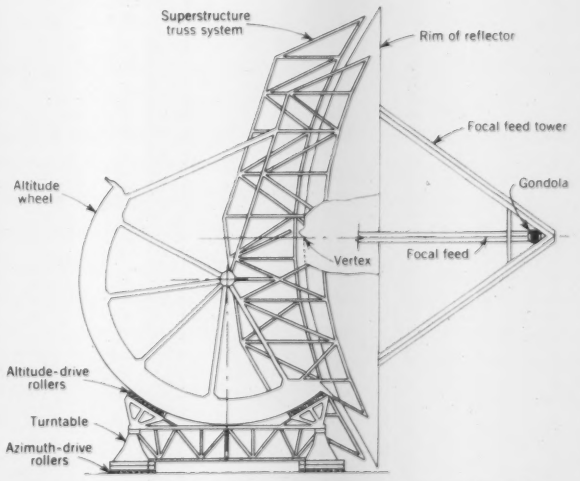
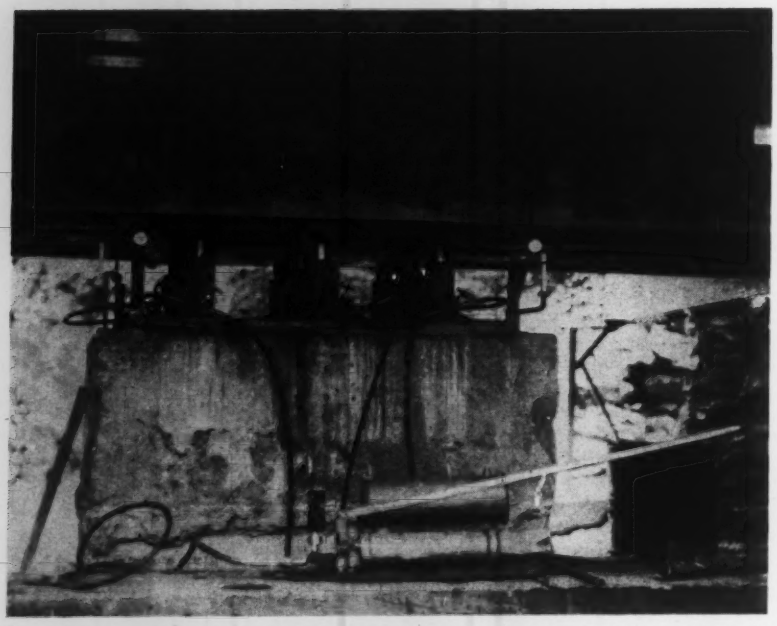


FIG. 1. The structural steel frame supports a parabolic antenna with aluminum mesh surface. Radio waves from outer space are reflected to the focal feed.



Bearing value of the soil was tested with hydraulic jacks on a 6-ft by 6-ft block.

accommodate irregularities in the tires and rims of the altitude wheels. Since the design will not permit backlash in the fore and aft direction, the drive assembly has a very high spring constant. To insure full bearing, the drive rollers are centered on the tire by means of idler rollers.

The 16 modules in a quadrant are interconnected through a hydraulic system to insure equalization of the load among all the rollers in a quadrant. This hydraulic system also permits lowering of the antenna structure onto stowing pads to relieve the drive rollers from possible overload from high winds, and to permit removal of rollers for repair and maintenance.

Loads from the altitude drive units are carried by the turntable, a rectangular framework of structural-steel trusses. The truss system transmits the vertical loads to the azimuth-drive rollers located at the corners of the turntable. The azimuth rollers bear on steel rails 10 in. wide and 4 in. deep. These rails in turn are supported on two circular foundations, 13 ft wide and 6 ft deep, which bear on shale. The turntable rotates about the pintle, a large bearing set in a mass of reinforced concrete 95 ft in diameter and 20 ft deep, Fig. 2.

The azimuth drive system (in the horizontal plane) is similar to the altitude system except that the antenna is designed to operate through 450 deg in azimuth. The total live and dead load of the antenna is transmitted to the two azimuth tracks through clusters of wheels located at the corners of the turntable truss; however, only the outer wheels are driven.

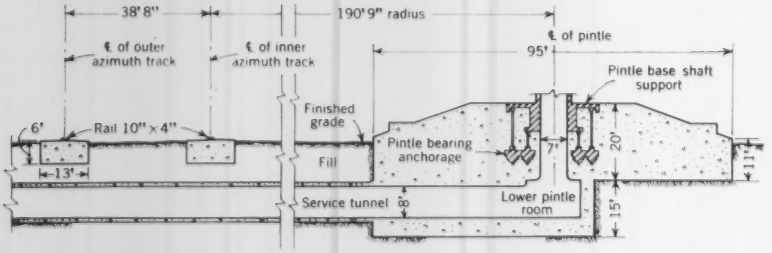
The altitude and azimuth drive rollers are powered by a system composed of an induction motor, two opposed eddy-current clutches, and a gear box. The overall gear reduction is 516:1, and the gear train is designed so that the clutches are always connected to the train and oppose each other to eliminate backlash. The driving torque in either direction is controlled by varying the exciting current of the eddy-current clutch.

The control signal to the drives is received from the Input Command Converter. This special digital equipment converts programs from sidereal to altitude-azimuth coordinates. Another control is the Inertial Reference System, which incorporates as its basic element an inertial platform. The platform provides information on where the axis of the telescope is pointing in altitude-azimuth coordinates. The basic elements of the platform are gyroscopes.

Some of the technical problems that are being solved and the research and development programs generated in meeting the challenge of the Big Dish are:

1. Determination of the finished grade elevation of the main site to insure adequate bearing for the foundations. Load tests up to 360 tons (10 tons per sq ft) were required to simulate actual loads imposed by the azimuth and pintle foundations. (One of these tests is shown in a photograph.)
2. Analysis of the highly redundant structure to achieve adequacy of design, maximum stiffness, equalized deflections, and minimum weight.
3. Dynamic analysis of the structure to determine lowest natural frequencies affecting the surface of the antenna.
4. Design of complex joints or weldments to provide distribution of shears and moments from two directions imposed by as many as thirteen main members intersecting at a panel point.
5. Design of the altitude wheels as curved box plate-girders 30 ft in depth, subjected to normal stresses plus compressive stresses at right angles due to loads from spokes and moving roller loads.
6. Wind studies of scale models of the antenna panels to determine drag factors. Studies to determine gust intensity and distribution.
7. Design of the aluminum panels to fine accuracy over the entire surface, supported to permit differential movement of the structural steel frame and aluminum panels and bonded to provide electrical continuity over the entire surface.
8. Erection of the structural steel and aluminum panels. Two movable towers, 90 ft square and 420 ft high, supporting cranes of 200-ft boom length, are required to reach all points on the structure.
9. Drive systems (altitude and azimuth) are required to support a maxi-

FIG. 2. Foundation for the pintle and azimuth tracks is seen in section. The 20,000-ton device is supported on two concentric circular tracks.



mum load of 635 and 760 kips per roller, respectively, without overstress to roller or rail. The power train for the drives must be designed with zero backlash to produce maximum tracking torque at a rim speed varying from zero to 1 rpm. The conventional design formulas for allowable wheel loading based on diameter and Brinell hardness are not applicable. A comprehensive testing program to extend Jensen's formula was required. The eddy-current clutches have been tested for accuracy and response to varying load as a basis for the design of the control systems.

The development of control systems for the components of the device, to insure adequate performance and over-all system compatibility, was equally important in meeting the precise operational criteria.

The site was selected after an exhaustive study to find a location that would not be subject to hurricanes, heavy snow or ice, earthquakes, or extreme temperatures. A low level of man-made radio interference is also very important as industry, commerce and densely populated areas are the sources of electrical interference that reduces the efficiency of radio telescopes. The West Virginia Legislature recognized the importance of protecting the area by passing a bill that limits the electrical noise permitted adjacent to radio astronomy installations.

The project will occupy two separate areas to minimize the possibility of creating unacceptable radio interference at the antenna. The main site will accommodate the large telescope, operations building, 60-ft radio telescope, and a small optical telescope. The support facilities site, which is four air miles from the main site, will include all personnel, administrative, shops and storage structures, and the power plant.

Construction scheduled

By September 1958, construction funds had been appropriated, preliminary engineering completed, and contract plans and specifications advanced to the point where construction could be scheduled. A joint venture consisting of Tidewater Construction Corp., Norfolk, Va.; Peter Kiewit Sons Co., Omaha, Nebr.; and Patterson-Emerson-Comstock, Inc., Pittsburgh, Pa., was selected as the prime contractor. The contractor is subcontracting all major phases of the project on a competitive lump-sum basis. The grading and access road for the main site is being built by the Nello L. Teer Co., Durham, N. C. Excavation amounts to more than 1.5 million cu yd. Blasting is not permitted.

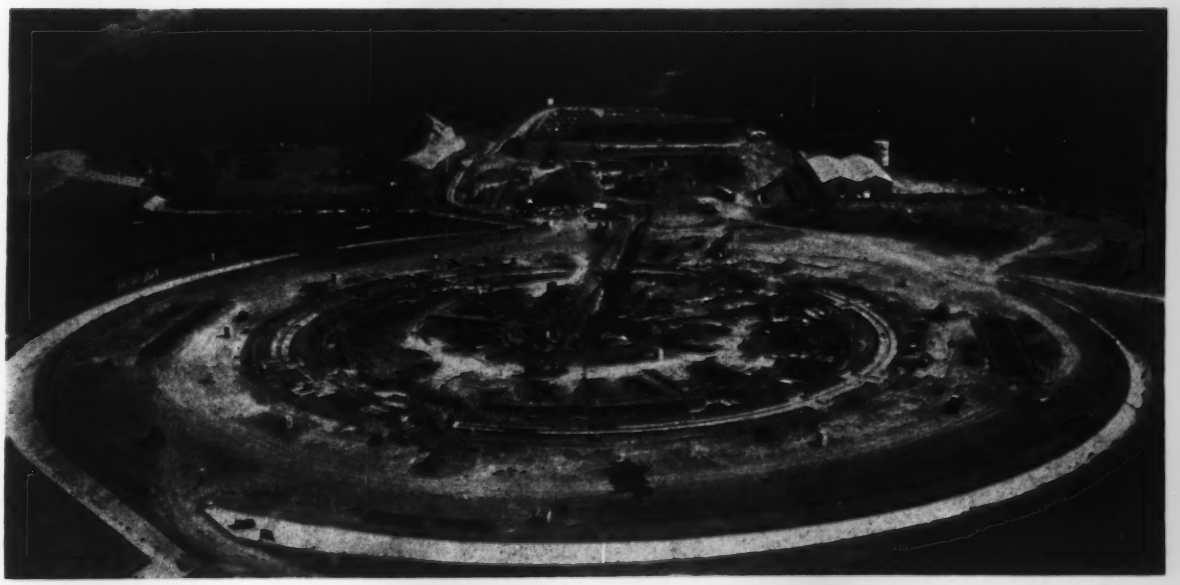
The American Bridge Division of the U. S. Steel Corp. was low bidder for the fabrication and erection of the structural steel and the erection of the aluminum panels. Baker & Coombs, Inc., of Morgantown, W. Va., holds the contracts for the foundations and the reservoir for the water supply system. Additional increments of the work will be placed under contract as the plans and specifications are completed by the architect-engineer contractor. However, the design of certain electrical and mechanical components has approached the current limits of the art, thus requiring research or testing programs to insure feasibility. The target date for completion of the Big Dish and its supporting facilities is 1962.

The Naval Research Laboratory is closely associated with all technical aspects of the project including, in part, the development of criteria, interpretation of requirements, review of research and engineering programs that lead to the preparation of contract plans and specifications, shop and field tests of components, and the final operational checkout of the radio telescope. J. H. Trexler has been designated as Technical Director by the Naval Research Laboratory.

The Chief, Bureau of Yards and Docks, Department of the Navy, Rear Admiral E. J. Peltier, CEC, USN, F. ASCE, is responsible for the project as part of the Navy's Military Construction Program. The project is assigned to the Officer in Charge of Construction, Fifth Naval District, Rear Ad-Admiral H. B. Jones, CEC, USN. The writer has been assigned to the project since the start of feasibility studies and is the Resident Officer in Charge of Construction at the site.

(This article is based on the paper presented by Mr. Tyrrell at the ASCE Washington, D. C., Annual Convention, before the Construction Division session presided over by Joseph F. Jelley, Jr., a member of the Division's Executive Committee.)

To prepare the site, the top of a knoll was leveled, and earth and shale were excavated to a maximum depth of 35 ft.



Pipe-flow formulas compared by nomograph

FRANCIS S. Y. LEE, F. ASCE, Ebasco Services, Inc., New York, N. Y.

Many exponential and approximate formulas for pipe flow have been presented since Chezy first proposed his equation, $V = C\sqrt{RS}$ in 1775. These formulas are often empirically applied to pipe friction problems without due consideration of the uniformity of resistance factors and their controlling influence, with the result that different answers are obtained by different formulas. The engineering applications of these formulas to pipe resistance problems and the resulting design calculations can be greatly clarified and simplified by a graphical comparison of the formulas.

As an example, three of the most commonly used formulas for the design of pipes flowing full under a steady condition are here graphically presented:

Darcy's modified Chezy formula:

$$h_f = f \frac{L}{D} \frac{V^2}{2g} \quad \ldots\ldots\ldots (1)$$

Manning formula:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} \quad \ldots\ldots\ldots (2)$$

Hazen-Williams formula:

$$V = 1.318\, C\, R^{0.63}\, S^{0.54} \quad \ldots (3)$$

In these formulas, all units are expressed in the foot-second system, with the following notation:

h_f = head loss
V = velocity of flow
g = gravitational acceleration
L = length of pipe
D = diameter of pipe
R = hydraulic radius = $D/4$
S = hydraulic slope = $\frac{h_f}{L}$
f, n, C = resistance coefficients

By replacing, equating and eliminating, the relationship of their coefficients f, n, and C becomes

$$f = \frac{257.6}{C^2} = \frac{185\, n^2}{D^{1/3}} \quad \ldots\ldots (4)$$

in which the coefficient C of the Hazen-Williams formula and the coefficient C of the Chezy formula are numerically equal. A graphical representation of Eq. 4 is given in Fig. 1.

Let $D = 5$ ft and $f = 0.015$.

Then $n = 0.0118$ and $C = 131$.

From Eq. 4 it seems clear that the resistance coefficients n and C in the Manning and Hazen-Williams formulas may be expressed in terms of f. Rearranging and substituting in Eqs. 1, 2, and 3, and letting h_f = head loss in ft per 1,000 ft, the following expressions are obtained:

Darcy:

$$h_f = 15.528\, f \frac{V^2}{D} \quad \ldots\ldots (1a)$$

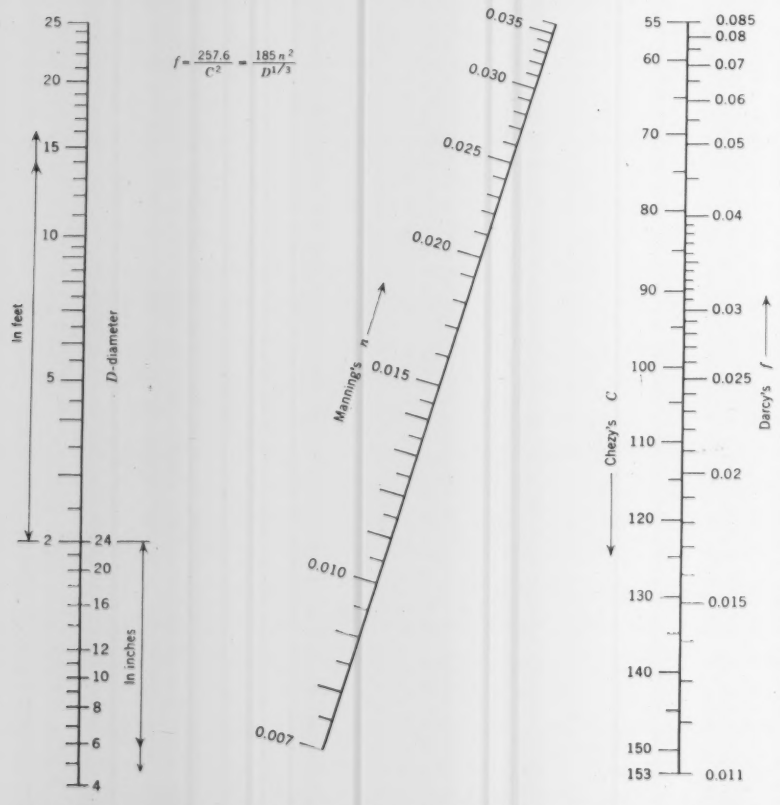


FIG. 1. Three resistance coefficients for pipes flowing full are compared—Manning's "n", Chezy's "C", and Darcy's "f."

Manning:

$$h_f = 15.513 f \frac{V^2}{D} \quad \ldots\ldots (2a)$$

Hazen-Williams:

$$h_f = 17.71 f^{0.925} \frac{V^{1.85}}{D^{1.166}} \quad \ldots\ldots (3a)$$

Self-explanatory curves based on the above three equations are given in Fig. 2. These curves indicate that for any given value of V and D, Manning's h_f/f is always less than Darcy's h_f/f by about 1.5 percent. That is, the h_f of Manning is always less than that of Darcy if the other factors remain the same. The value of h_f/f by the Hazen-Williams formula varies in general from greater to smaller than that by the Darcy formula as the values of both D and V increase from zero to 30, as shown in the curves. It is evident that, with the non-uniform hydraulic exponents, the Darcy and Hazen-Williams formulas will not give a similar geometrical interpretation. For small values of D and V (say less than 1), the h_f/f of Hazen-Williams becomes higher than that of Darcy, but as the D and V values gradually increase, the h_f/f of Hazen-Williams becomes smaller than that of Darcy. Where $D = 28$ and $V = 30$, the difference in the values of h_f/f is so substantial that the ratio of the Hazen-Williams h_f/f to the Darcy h_f/f is approximately 1:2.

For any combination of D and V in pipe-flow problems, these curves will afford a visual comparison of the three resistance formulas under consideration. If the problem involves the discharge instead of the velocity, similar types of equations and diagrams can be obtained.

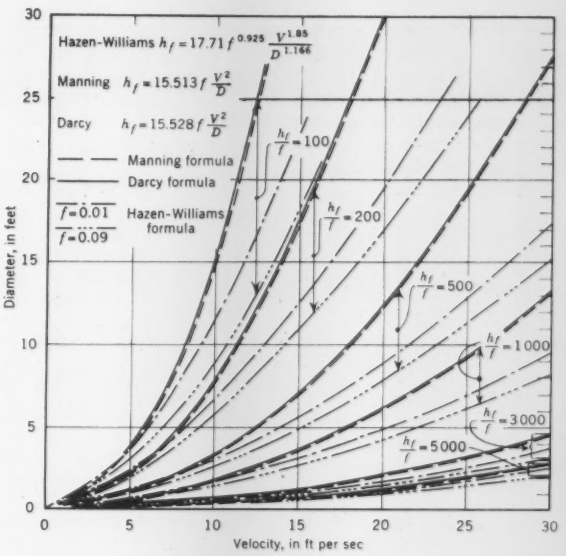


FIG. 2. Curves show velocity-diameter and h_f/f relationship for three formulas for pipes flowing full —those of modified Darcy, Manning, and Hazen-Williams. See Eqs. 1(a), 2(a), and 3(a).

It is to be observed from the above discussion that, through the use of Fig. 1, the Manning and Hazen-Williams formulas can be solved more directly by the relative roughness criterion, K/r_o, which in recent years has been commonly applied by most experts to pipe friction problems.

The relative roughness, K/r_o, was designated originally by J. Nikuradse, K being the dimension of the sand grains and r_o the radius of the pipe. See J. Nikuradse, "Stromungsgesetze in rauhen Rohren," V.D.I., *Forschungsheft*, No. 361, 1933 p. 18. See also L. F. Moody, "Friction Factors for Pipe Flow," *Transactions*, ASME, Nov. 1944, pp. 671–684; H. W. King, *Handbook of Hydraulics;* and H. Rouse, *Engineering Hydraulics*.

Factors of safety for a footing against overturning or sliding

W. BERTWELL, F. ASCE

Chief Design Engineer, Kaiser Engineers

Division of Henry J. Kaiser Company

Oakland, Calif.

There is considerable disagreement on the determination of factors of safety for a footing against overturning and sliding. At least one excellent book on foundations, written by a well qualified member of the profession, provides erroneous values for an independent footing subjected to an inclined overturning force. A number of other practicing engineers regularly apply these same incorrect factors. Lack of a common definition may be the reason. In the following discussion, the factor of safety is the factor by which the active overturning or sliding force is multiplied to produce the corresponding failure. Three cases will be considered—an independent footing, two footings connected by a strut, and two footings without a strut.

An independent footing

Consider a single symmetrical footing (Fig. 1, upper right) of width b, carrying a total gravity load W, and serving as an anchor for an inclined force P, with components H and V applied at the center of the footing and at a height h

above the bottom of the footing. The force being anchored may vary in amount, but not in direction or point of application. Passive resistance of the soil is neglected. For this simple condition the values of G, the factor of safety against overturning, are:

$$\text{Erroneous: } G = \frac{(W - V)\frac{b}{2}}{Hh}$$

$$\text{Correct: } G = \frac{\text{Resisting Moment}}{\text{Overturning Moment}}$$

$$= \frac{W\frac{b}{2}}{Hh + V\frac{b}{2}} \quad . \quad (1)$$

The corresponding values of G_s, the factor of safety against sliding, are:

$$\text{Erroneous: } G_s = \frac{(W - V)f}{H}$$

$$\text{Correct: } G_s = \frac{Wf}{H + Vf} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Two footings connected by strut

Some confusion arises because the preceding erroneous values are correct for a special case, the symmetrical bent supporting an elevated structure, with a strut at the tops of the footings. See Fig. 1 (main sketch).

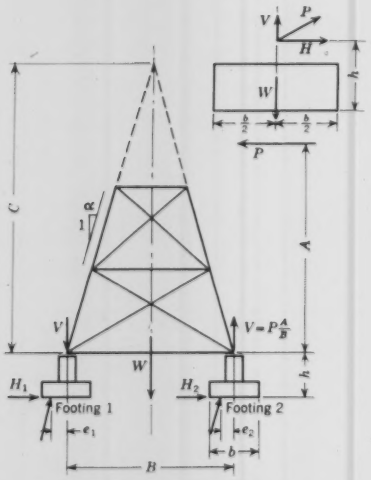


FIG. 1. Two cases are illustrated: simple footing, at upper right, and two footings connected by a strut, in main sketch.

Because of the presence of the strut (or stiff diagonals in the bottom panel of the bracing instead), the two footings will overturn together, and must consequently have the same factor of safety, G. At any value of the force P, less than that causing overturning, equilibrium of the footings requires:

$$\text{At footing No. 1, } \left(\frac{W}{2} + V\right)e_1 = H_1 h \quad . \quad . \quad . \quad . \quad (3)$$

$$\text{At footing No. 2, } \left(\frac{W}{2} - V\right)e_2 = H_2 h \quad . \quad . \quad . \quad . \quad (4)$$

When P reaches the overturning value, GP, $e_1 = e_2 = b/2$.

At that stage the proportion of H_1 to H_2 must be: $\dfrac{\frac{W}{2} + VG}{\frac{W}{2} - VG}$

At smaller values of P the ratio of H_1 to H_2 is not evident, but it depends solely on the relationship between the total vertical loads on the two footings. Since H_1 and H_2 are in the same ratio as the total vertical loads on the two footings, both as P approaches zero and as P approaches GP, a reasonable assumption is that this proportion persists for intermediate values of P.

For this assumption, $e_1 = e_2$ at all times and

$$\frac{H_1}{H_2} = \frac{W + 2V}{W - 2V} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Adding Eqs. 3 and 4,

$$\frac{1}{2}W(e_1 + e_2) = We = W\frac{b}{2G}$$

$$= (H_1 + H_2)h = Ph$$

$$\text{and } G = \frac{W\frac{b}{2}}{Ph} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Substituting for e_1 and e_2 in Eqs. 3 and 4,

$$G = \frac{\left(\frac{W}{2} + V\right)\frac{b}{2}}{H_1 h} = \frac{\left(\frac{W}{2} - V\right)\frac{b}{2}}{H_2 h} \quad . \quad . \quad (7)$$

The relationships of Eq. 7 are in the same form as the previously given erroneous value for an independent footing. The validity of Eq. 7 for this special case depends on the equality of e_1 and e_2 and the resulting proportion:

$$\frac{\frac{W}{2} + V}{H_1} = \frac{\frac{W}{2} - V}{H_2} = \frac{W}{P}$$

Similarly, for sliding, the proportionality of vertical to horizontal reactions gives:

$$G_s = \frac{\left(\frac{W}{2} + V\right)f}{H_1}$$

$$= \frac{\left(\frac{W}{2} - V\right)f}{H_2} = \frac{Wf}{P} \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Two footings without a strut

When the strut at the tops of the footings is omitted and the diagonal bracing used is capable of carrying tension only, footing No. 2 is critically loaded. Several cases are possible:

1. Columns vertical. Here the entire lateral shear is delivered to footing No. 2.

$$G = \frac{W\frac{b}{4}}{Ph + V\frac{b}{2}} \qquad G_s = \frac{\frac{W}{2}f}{P + Vf}$$

2. Columns battered, where $C > A$. Diagonal to footing No. 2 acts as follows, where the total gravity load above the footing is W_c:

$$H_1 = \alpha\left(\frac{W_c}{2} + V\right)$$

$$H_2 = P - \alpha\left(\frac{W_c}{2} + V\right)$$

At overturning of footing No. 2,

$$\left(\frac{W}{2} - GV\right)\frac{b}{2} =$$

$$\left[GP - \alpha\left(\frac{W_c}{2} + GV\right)\right]h$$

$$GPh + GV\left(\frac{b}{2} - \alpha h\right) = \frac{Wb}{4} + W_c\frac{\alpha h}{2}$$

$$G = \frac{\frac{1}{2}\left(W\frac{b}{2} + W_c\,\alpha h\right)}{Ph + V\left(\frac{b}{2} - \alpha h\right)}$$

At sliding of footing No. 2,

$$G_sP - \alpha\left(\frac{W_c}{2} + G_sV\right) = f\left(\frac{W}{2} - G_sV\right)$$

$$G_s = \frac{\frac{1}{2}(Wf + W_c\,\alpha)}{P + V(f - \alpha)}$$

3. Columns battered, where $C < A$. The diagonal to footing No. 1 acts as follows:

$$H_2 = -\alpha\left(\frac{W_c}{2} - V\right)$$

At overturning,

$$\left(\frac{W}{2} - GV\right)\frac{b}{2} = -\alpha\left(\frac{W_c}{2} - GV\right)h$$

$$G = \frac{\frac{1}{2}\left(W\frac{b}{2} + W_c\,\alpha h\right)}{V\left(\frac{b}{2} + \alpha h\right)}$$

At sliding,

$$-\alpha\left(\frac{W_c}{2} - G_sV\right) = f\left(\frac{W}{2} - G_sV\right)$$

$$G_s = \frac{\frac{1}{2}(Wf + W_c\,\alpha)}{V(f + \alpha)}$$

THE READERS WRITE

Stature for civil engineers

To THE EDITOR: Before my recent application for ASCE membership, I received a "get-acquainted" copy of the August 1959 issue of CIVIL ENGINEERING. The article that interested me most was Mr. Florman's "The Civil Engineer in Fiction." He mentions A. Strindberg's *The Story of the St. Gotthard*. The chief engineer of this famous tunnel was Henri Favre of Geneva, a top-notch civil engineer who, like many other notable men in science and engineering, was honored by the Swiss Government by a special postage-stamp issue, proof of the high standing of the profession among the Swiss.

This review touched naturally only on the best-known novels and stories. I remember a novel by the Swiss writer Jakob Heer, *An heiligen Wassern* ("At the Sacred Waters"), dealing with an intricate irrigation system in southern Switzerland not far from the Matterhorn. A huge success in 1920, this novel probably never reached an international audience. But it showed civil engineering at its best and, I am sure, inspired many a young man to join the profession.

At the close of the article, Mr. Florman deplores that here in the United States the civil engineer is generally unhonored and unsung. There must be many reasons for this attitude. One way to get the answers would be to open a brainstorming session on this subject with all the readers participating. When compiled and classified, the answers would probably reveal the truth. Maybe we have to change *our* attitude before we get more recognition.

FRANK D. STEINER

Moraga, Calif.

Elephant Butte Dam celebrated in fiction

To THE EDITOR: The article entitled "The Civil Engineer in Fiction," by S. C. Florman, in the August issue (vol. p. 544), was very interesting. This information is valuable for a high type of public relations.

No mention was made of a novel by Lenore Wilsey, called *Still Jim*. The setting of the story was the famous Elephant Butte Dam, during construction. The dam was completed in 1916 and the book was probably published about that time.

I believe that Lenore Wilsey's husband was an engineer engaged in the construction of Elephant Butte Dam. Her novel was well known among engineers of the West in the early days of reclamation.

FRANK B. CAMPBELL, F. ASCE
Consulting Engineer

Vicksburg, Miss.

Professional status won through understanding

To THE EDITOR: Recent discussions in CIVIL ENGINEERING and other engineering periodicals have indicated dissatisfaction with the current professional standing of engineers and the difficulty of establishing and maintaining professional standing.

It seems to me that engineers are professional people who operate in a business world. It is impracticable to attempt to change the business world.

Business people usually take what they consider to be fair and appropriate action in business circumstances. They can understand that professional engineers also take what they consider to be fair and appropriate action in professional circumstances.

Differences can be most easily resolved by understanding that such differences are caused by circumstances rather than by people. Where respect is earned by mutual understanding, there results more or less automatically a satisfactory professional status for engineers and the engineering profession.

A. H. DAVISON, F. ASCE
Civil Engineer

Glens Falls, N. Y.

Lateral deflection and permissible loads for columns

To THE EDITOR: In connection with Donald Bregman's article, "Determining the Lateral Deflection and Permissible Loads on Columns," in the October issue (vol. p. 714), three points should be mentioned:

1. In Table I, Mr. Bregman is actually comparing the first Euler critical load for an ideal column of length L with the load prescribed by the AISC column formula, since in Bregman's Eq. 13,

$$\frac{P}{A} = \frac{F}{fL^2}\frac{\pi^2 kr^2}{} = \frac{\pi^2 E}{f(L/r)^2}$$

For $E = 2.9 \times 10^7$ psi and $f = 2.0$, the two curves intersect at $L/r = 118.3$.

2. Mr. Bregman has assumed an initially imperfect column, which will not buckle in the true sense of the word, but rather fail when the tensile stress in the extreme fiber exceeds the maximum permissible tensile stress for the column material. Yet his results are strictly applicable only to ideal columns. True buckling implies an instantaneous and indeterminate deflection rarely achieved even in laboratory tests.

3. One formula developed to treat imperfect columns is the Secant Formula,

$$\sigma_{max} = \frac{fP}{A}\left(1 + \beta \sec \frac{L}{2r}\sqrt{\frac{fP}{AE}}\right)$$

where β = degree of initial imperfection prior to loading. The AISC column formula,

$$P/A = 17{,}000 - 0.485\,(L/r)^2$$

is a simplified expression fitted to values obtained by setting $\beta = 0.25$ in the Secant Formula.

DOUGLAS H. MERKLE, A.M. ASCE
2nd Lt, USAF
Asst. Installations Engr.

Indian Springs, Nev.

More about column loads and deflections

To THE EDITOR: In the Engineers' Notebook article, "Determining the Lateral Deflection and Permissible Loads on Columns," by Donald Bregman, in the October issue (vol. p. 714), a couple of things puzzle me.

What has the uniformity of the cross section of the column got to do with the neglibility of the shearing forces? (This is his third point in the second paragraph.)

Also, since according to the author $k = E/F$, Eq. 13 seems to be nothing but the Euler formula with the factor of safety f introduced. In other words the author is back to Eq. 2, with which he started, except for the negligible difference represented by L and L_1.

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Troy, N. Y.

Straightening the record on "Busy New York Bridges"

To THE EDITOR: In the article, "Busy New York Bridges Celebrate 50 Years of Service," in your August issue (p. 96), there are a few minor errors in need of correction.

Referring to the Queensboro Bridge, "David" Lindenthal is named as the designer. Mr. Lindenthal's given name was "Gustav" not "David." He was an Honorary Member of the Society.

As for the Manhattan Bridge, the late Leon Moissieff, M. ASCE, was Chief of the Design for the City Department of Bridges. In the design of this structure he developed and used the deflection theory for the first time in this country. In the mention of the consulting architects for this bridge (Carrere and Hastings), the late Mr. Carrere's name is given as "Carrète."

F. H. FRANKLAND, F. ASCE
Frankland and Lienhard
Consulting Engineers

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SOCIETY NEWS

A Success Story—the 1959 Annual Convention

The gavel, symbol of office, changes hands during the Convention, as Frank A. Marston is installed as 91st President of ASCE. Retiring President Friel is at right.

President Friel presents the Construction Engineering Prize to Edward E. White. The Construction Engineering Prize is the only Society award for a "Civil Engineering" paper.

The Washington Convention of ASCE turned out to be one of the best attended and most enthusiastic meetings ever held by the Society. More than 2,100 registered for the events to hear some 175 papers representing all the 14 Technical Divisions, watch the induction of five Honorary Members and the award of Society prizes, and see retiring President Francis Friel turn over the gavel to Frank Marston of Boston.

Washington's fall weather was perfect for most of the meeting, which took place the week of October 19. The special ladies' program included tours through the White House and the environs of the capital city. The National Capital Section was the perfect host, anticipating the needs and interests of the visitors. Representatives of many branches of the government were at the meetings, ready to explain government activities.

The serious interests of the engineers were reflected in capacity attendance at professional practice meetings as well as almost every technical session. General functions were sell-outs all week. Probably more people than ever before attended the general business meeting of the Society and the Awards Luncheon that followed.

Installed as the 91st president of the Society, Mr. Marston urged in his keynote address the strengthening of the organizational structure of the Society so "that it does not become professionally impotent" in meeting the challenges of technological demands and developments. President Marston's address appears on page 33 of this issue.

Awards Luncheon

Newly inducted President Marston presided over the Awards Luncheon on Wednesday highlighted by the conferring of honorary memberships on five distinguished civil engineers. Those selected for this honor by their fellow engineers were: Herbert A. R. Austin, consulting engineer, Honolulu, Hawaii; Glen E. Edgerton, Major General, U. S. Army (Ret.), and former president of the Export-Import Bank of Washington; Julian Hinds, consulting engineer, Los Angeles, Calif.; Frank M. Masters, consulting engineer, Harrisburg, Pa.; and Gustav J. Requardt, consulting engineer, Baltimore, Md. (For biographies see CIVIL ENGINEERING for October 1959.)

Featured speaker for the occasion was the Chief of Engineers, Lt. Gen. Emerson C. Itschner. General Itschner told the group, in discussing registration and society participation, "that registration reflects an element of professional prestige that encourages a man to do his best work. It gives him a sense of responsibility to inspire and guide him. It gives him a mark of stature among other members of the profession that can be gained by no other means. In sum total," he said, "it makes him a better engineer—it makes him measure up."

Scene at registration desk on opening day of the Washington Convention when 1,200 tried to register more or less simultaneously. A total registration of 2,140 made it one of the largest Conventions ever.

Nuclear Power Luncheon

A near record crowd attended the Nuclear Power Luncheon at which Brig. Gen. A. C. Welling, Engineer Commissioner of the District of Columbia, extended greetings from the City of Washington to the group of engineers and their guests. Retiring President Friel read a letter from President Eisenhower in which he said that "with imagination, competence, and a high sense of purpose, the members of ASCE have gained wide renown as builders of strength." The President wished the engineer visitors every success for the meeting and the future.

A topic of special interest to the engineers was presented by the Hon. John F. Floberg, commissioner of the Atomic

Energy Commission, who discussed the civil engineer's role in civilian nuclear power. He stated that AEC is currently spending $300 million a year, including funds for construction, research, and development. Advances in engineering, Commissioner Floberg continued, are making nuclear energy both economical and profitable.

Project Plowshare, the AEC chief said, is an attempt to determine peaceful applications for nuclear explosion. He cited as an example a project in Alaska in which possibilities of excavating by nuclear explosions are being investigated. Other peaceful uses of nuclear explosions are power and the recovery of oil from oil shale or sand. Commissioner Floberg told the group that the civil engineer has played and will continue to have an opportunity to play a role of prime importance in peaceful application of nuclear energy.

All Engineers' Luncheon

Tuesday's luncheon was the occasion for an address by Dean Nathan W. Dougherty, Honorary Member of ASCE and dean emeritus of the College of Engineering at the University of Tennessee. In speaking to the group on "The Responsibilities of Engineers to the Public." Dean Dougherty stated that "every engineer who is licensed to practice becomes a guardian of the public health, public safety, and public welfare. The goal of engineering is the health of the industrial body just as the goal of medicine is the health of the physical body." Both of these disciplines involve the same temptations, the same dangers and the same moral obligations. The engineer's responsibilities, he concluded, will not allow him to take a quick profit on "the public be damned" theory, but instead he must stand in for "the least of these my children," and be their agent and guardian against danger, disease, and disaster.

General Membership Luncheon

The hidden peril to our industrial prosperity now and in the years ahead is the growing pollution of our environment—air, water, soils, and food—Mark D. Hollis, chief engineer and assistant surgeon general of the U.S. Public Health Service, told engineers attending the general membership luncheon. Although a great deal has been done in the past few years by our local, state, and federal governments to control water pollution, the hard fact is that the avalanche of change brought about by our exploding population in a technological age presents a challenge that could mean our very survival as an industrial power. Mr. Hollis concluded by saying that our immediate problem is to lay out a national program to combat the inimical effects of modern technological development on the water we drink, the food we eat, and the air we breathe.

Civil Defense Luncheon

The Governor of West Virginia, the Hon. Cecil H. Underwood, was featured speaker at the State Planning and Civil Defense Luncheon on Friday. The governor told the group that his state has a number of rock caverns where industry could find safety in the event of atomic attack. He said that one of the caverns covers 20 acres and is 30 ft high.

Conditions of Practice Sessions

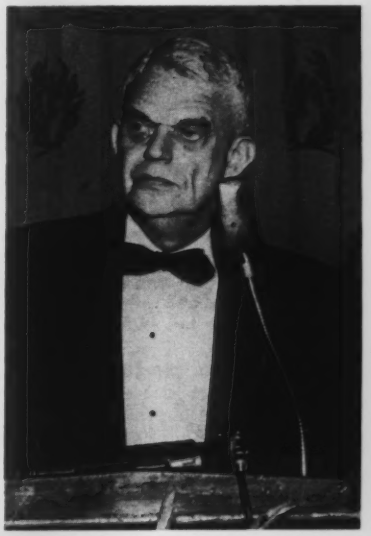
Ever-increasing interest in professional matters was shown by standing room only attendance at Conditions of Practice sessions held each morning from 11 to 12. Discussion following the papers on registration brought out the information that (1) Enforcement of registration laws is difficult—more "guts" in registration boards would help, (2) the Model Law will not adequately cover surveying, and (3) provision should be made for foreign engineers to practice in this country. Failure to take the latter action could result in curtailment of the work of U.S. engineers abroad.

In a talk on pending legislation of interest to engineers, Carl E. Johnson, attorney for the Post Office and Civil Service Committee, said all people seem to think better when they see more money. Top salaries in government are limited by Congressional pay and scaling downward from that. An effort is being made to permit selection of more top personnel by high administrative officials.

Salaries of new engineering graduates, on their first jobs, have increased 65 percent in the past eight years, according to Robert K. Lockwood. Surveys have indicated a rapid growth of engineering salaries, he reported, but there are still areas where they have not kept pace with a spiralling economy. ASCE has formed a Committee on Employment Conditions to prepare data and recommend suitable courses of action in connection with fair and ethical treatment to be accorded both employees and employers. The Society also conducts a biennial salary survey which, Mr. Lockwood said, has been used effectively by engineers to achieve for themselves salary levels commensurate with the work they are doing.

In a paper presenting the present status of state registration laws, William M. Spann stated that, "Of the some 650,000

At the annual banquet Dr. Henry T. Heald, president of the Ford Foundation, received the Hoover Medal, joint award of the Founder Societies for distinguished public service. In the featured talk at the annual dinner of the American Institute of Consulting Engineers, Dr. Heald announced Foundation grants of $19 million to further engineering education.



On the dais at business session of the Society's Annual Convention are ASCE Vice-Presidents Paul Holland and Lloyd Knapp (left) with retiring Vice-Presidents Waldo Bowman and Samuel Morris.

President Friel (right) presents the Norman Medal, the Society's most distinguished prize, to co-winners Charles R. Foster (left) and Willard J. Turnbull. At Mr. Turnbull's left is Howard F. Peckworth, chairman of the Publications Committee.

Consulting engineers hold a corridor conference as Charles M. Wellons (left), of Pittsburgh, stops to chat with C. E. Blee (center), former chief engineer of the TVA and now of Pasadena, and George S. Richardson, also of Pittsburgh and president of the American Institute of Consulting Engineers.

engineers in the United States, an estimated 238,000 are registered professional engineers." He continued "The day of full uniformity in interstate registration is far ahead, but we must say that excellent progress toward that goal has been made." An important factor in the development of registration has been the organization of the National Council of State Boards of Engineering Examiners, a group made up of the membership of the boards of each state. By the exchange of ideas and with the support of the technical societies of the nation and the full cooperation of the State Boards, marked progress and advancement in registration can be assured, Colonel Spann said.

In 1958 some 65 percent of the members of ASCE were licensed professional engineers; another 14 percent were engineers in training, said Charles W. Griffin, Jr., vice-chairman of the ASCE Committee on Employment Conditions, in a talk on trends in employment conditions as indicated by the Society's 1953 and 1958 surveys. Only 108 of 21,000 Society members who replied to the survey questions said they wanted to be labor union members. About 18 percent of the Society's members believe that collective bargaining is, or would be, advantageous to them but only 14 percent would voluntarily join a union, while 38 percent would join a professional union if necessary to hold their jobs. The one primary reason for favoring a union was "economic benefits."

Speaking on engineers in public practice, Irving F. Ashworth said, "The civil engineer with little or no executive duty finds, despite heavy personal responsibility in his field of activity, that organization and personnel policies tend toward the impersonal acceptance of his position as an organizational element. He is apt to be viewed merely as a technician with certain specialized aptitudes and for whom certain perquisites and pay scales are pertinent, based upon availability of replacement. Quite often, several layers of administrative officers intervene between the engineer and officials with whom decisions rest." Commenting on remuneration, Mr. Ashworth said that the gap in benefits between public and private employ narrows considerably when the factor of tenure and other benefits are considered. There is now a tendency in certain areas of private employment to utilize wage schedules in public employment as a base, and to add a differential to obtain a competitive advantage over service in recruitment and retention of employees.

One of several Conditions of Practice sessions featured talks by (left to right) Don Corbett, Frank Weaver, Paul L. Holland (at the speaker's stand), Carl E. Johnson, attorney for Post Office and Civil Service Commission, Frank Butrico, and Alfred R. Golze.

Civil Engineering Show

The third ASCE-sponsored commercial Civil Engineering Show was held in conjunction with the Annual Convention and offered those attending an opportunity to view demonstrations of equipment, materials, tools, and methods. A total of 39 exhibitors added much to the success of the meeting by providing engineers to supply answers to specific technical questions. The exhibitions included new and advanced photogrammetric equipment, operating computers, and a complete line of surveying instruments used daily by civil engineers. The U.S. Steel Corporation included in its display models of the winning bridges in its Bridge Design Competition. An announcement of the awards in the design competition appears elsewhere in this issue.

Student Activities

Almost 200 students from eleven U.S. colleges and universities and from foreign countries, including Trinidad, Tur-

key and Pakistan, attended the Washington meeting. Students were in attendance at many of the technical sessions, and at the Student Chapter Conference they were greeted by President Marston. Topics of discussion were financial operation of a successful Student Chapter; programs and their importance to the Chapter; and the annual report which each Chapter sends to headquarters.

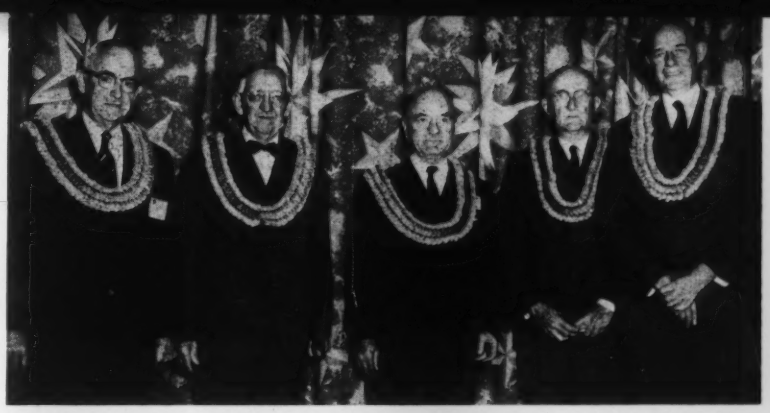
Ladies' Program

Headed by Mrs. Eugene Baldi, the Women Activities Committee planned a complete and fun-filled program for the wives of the engineers attending the convention. The Nation's Capital City had many points of interest for the visiting ladies. In addition to the tour of the White House, there were trips to places of interest in Virginia—among them famed Mount Vernon. Washington's famous churches were a focal point of attraction for many of the visitors. A highlight of the ladies' program was a visit to the studios of the Voice of America where programs are constantly prepared and broadcast throughout the entire world.

A number of the women, of course, accompanied their husbands to the daily luncheons, the Kickoff Cocktail Party, and other social functions. The Women's Hospitality Room featured a morning coffee hour and afternoon tea for the pleasure of the visiting ladies.

Sincere Thanks Are Due

The thanks of all who attended the Convention go to the National Capital Section and, especially, to Eugene F. Baldi, Convention chairman; Eugene W. Weber, chairman of the Technical Program; and Mrs. Eugene F. Baldi, chairman of the Women's Activities Committee. The success of the Convention is a measure of the time and effort volunteered by the members of the National Capital Section and their ladies. They did a job that will long be remembered.



Annual Convention highlight was the presentation of Honorary Memberships to five distinguished civil engineers. In usual order they are Herbert A. R. Austin, Frank M. Masters, Glen E. Edgerton, Julian Hinds, and Gustav J. Requardt. Since Mr. Austin is from Hawaii, the newly elected Honorary Members were presented with leis of tiny orchids by his daughter, Mrs. Jean Smith.

National Capital Section committeemen R. S. Goodridge, registration chairman; Carl H. Walther, chairman of Student Committee; Eugene F. Baldi, general chairman; Henry W. Hemple, hotel chairman; and Eugene W. Weber, technical program chairman. These people did a wonderful job.

ASCE Technical Program Reviewed

Emphasis on the importance of Washington in stimulating and financing developments in other countries and the part American engineers play in world construction highlighted technical sessions of the Washington Convention. The need for irrigation in humid areas to correct seasonal and geographical deficiencies and the means being used around the world to find and provide water were featured in a dozen papers.

Opportunities for engineer constructors in developing power in other lands were stressed. Work being done on the highways of the world was described. Problems of the U.S. military in finding water, promoting sanitation, and teaching how to build with safety on foreign bases were outlined by top officials. Other papers covered most of the wide interests of ASCE members. Several featured items of outstanding interest in Washington and its environs.

Developing Water Resources

How the U.S. Bureau of Reclamation has expanded its activities to include technical assistance on water resources to 30 countries of the world was described at a Power Division session by Alfred R. Golze, Assistant Commissioner and recent president of the National Capital Section. After 57 years, spent primarily in developing water resources in 17 Western states, the Bureau is now providing technical assistance to foreign countries, chiefly in the form of training foreign nationals at its various field installations, providing specialized short-term technical assistance, and directing long-term engineering and economic investigations on assignment. The Bureau has sent overseas over 100 technical groups or missions including more than 300 Bureau of Reclamation personnel to some 30 different countries, all at the express request of the countries involved. Since 1949, the Bureau has registered 1,060 engineers, economists, and others from 49 countries for training at the Bureau's offices and projects in this country.

Irrigation—the Great Need

India has a potential food crisis that "dwarfs all famines in her history," Alfred C. Ingersoll, associate professor of civil engineering at California Institute of Technology, told a session of the Irrigation and Drainage Division. India has 58,000,000 acres under irrigation, second only to China. Irrigation will continue to play a leading part in increasing food production. Professor Ingersoll concluded, "India remains today the world's leading country in the science and techniques of irrigation engineering, and certainly the one with the best recorded history for the edification of the

civil engineer in the western world. Despite the developments of the past 70 years in the United States, American engineers still have much to gain by Indian experiences."

"Now, as in ancient times, successful development of irrigation in the valley of the Tigris and Euphrates is greatly dependent on good engineering, progressive laws, efficient administration, and a condition of peace and cooperation with neighboring countries," said Stanley S. Butler, associate professor of civil engineering at the University of Southern California.

"As is true in many other parts of the world, including the United States, the biggest problem in Iraq today is to gain public support for developing a strong, well-paid staff of engineers, providing for adequate agricultural drainage, guarding against over-development of groundwater basins, and establishing and maintaining a strong program of collecting basic agricultural and hydrologic data for the most efficient planning and operation of the work."

Irrigation in the tropical countries of Latin America is just beginning, said L. S. Willardson, agricultural engineer of the U.S. Department of Agriculture, Logan, Utah. Until very recently the technology to control the unusual tropical conditions has not been available. New developments including heavy equipment for land clearing and rapid land preparation, and new herbicides, insecticides, and fungicides should open a new era of food production in tropical countries. A pioneer in irrigation in the tropics has been the United Fruit Company, of Boston, which irrigates its banana plantations. The company has effectively reclaimed many thousands of acres of jungle-covered wasteland for successful banana production.

Mr. Willardson noted that present world food surpluses are temporary and that new land development will be needed.

Another speaker, J. E. Christiansen, professor of civil and irrigation engineering at Utah State University, reported that nearly all the irrigation in Uruguay is the result of private enterprise, mostly by individuals who pump water directly from perennial streams or lakes to irrigate adjacent lands. Professor Christiansen said, water supply is not readily available to most of the land area and Uruguay's farmers have had little experience with irrigation.

In Ceylon, rainfall varies from a maximum of 228 in. a year to a minimum of 36 in. Even so, said Philip P. Dickinson, a civil engineer and technical assistant to Senator Clair Engle, Ceylon has to have irrigation to produce food for its growing population. Even now Ceylon has to import about half of its food. Ceylon is hot and humid, but maldistribution of rainfall, both seasonally and geographically, makes irrigation essential especially for rice growing, which here requires 130 in. of water per crop. An American advisory team of technical assistants is now in Ceylon under the International Cooperation Administration to help the government plan solutions for its food problem. One solution may be hydroelectric facilities, to provide power for better irrigation and drainage.

In the United States, there is enough water, but frequently not where it's needed most, said Carter Page, chief of the planning division, Office of the Chief of Engineers. Water shortages exist in many areas. The U.S. Geological Survey found, in 1953, that there were a thousand cities, from those of moderate size up to large municipalities, which actually had to resort to a restricted use of water. This means that the waste of water must be curbed, pollution reduced, and survey studies and works and construction expedited.

The uneven distribution of water supply, Mr. Page noted, "is a hard nut to crack." The problem of geographic distribution is illustrated by the State of California, where most of the water originates in the northern part of the state and most of the demand is in the south.

On the average about two-thirds of our stream flow passes to the sea as flood water during a few months of the year. Without regulation, much of this is lost to us as supply, and from it we suffer a terrific cost in food damage.

Power Expansion

Speaking on "An Engineer-Constructor's Role in World Wide Power Expansion" before a Power Division session John P. Buehler, manager of hydroelectric power, Bechtel Corporation, estimated that world power consumption would double in the next ten years. Within the next five years power use in Europe, including Russia, is expected to exceed that of North America. Proportionately, other parts of the world will have experienced even greater growth. Forecasters predict that Asia will triple her consumption and that South America will quadruple hers. Only in the nuclear field does the United States engineer have much opportunity for work in Western Europe. While important work has been done by the British, French and Russians, most of the engineering and construction knowledge of nuclear installations is centered in the United States. In newly developing countries there is more opportunity. As the engineer-manager, a U.S. firm would ordinarily design the installation, then supervise and coordinate the work of local subcontractors in the construction phase.

In a paper on "Influence of Local Growth" S. P. McCasland, chief hydroelectric engineer for Ebasco International Corporation, New York, said a hydro project ordinarily entails a heavy initial outlay for civil engineering works because the dam, tunnels, and other installations must be built to ultimate size at the outset, even though the installation of some of the generating units may be

Speakers at an Irrigation and Drainage Division session were (in usual order) A. C. Ingersoll, Philip P. Dickinson, and Royce J. Tipton.

Highway Division session brings together (left to right) Archie N. Carter, Patrick Healy, Jr., Bernard Hillenbrand, Roy Jorgens, Hal Aiken, and F. C. Turner.

postponed. Also a transmission line must be built from the hydro site to the load center. Although the incremental cost of adding future units may be small, and the project's final average cost per kilowatt correspondingly low, interest on the early investment, during the years before the complete installation is needed, may be a critical factor. Thermal additions have a more uniform cost per kilowatt, and consequently entail a more gradual rate of investment with a lesser penalty in interest charges.

Managing a World-Wide Construction Program

In considering the major problems of the Navy's far-flung construction program, Adm. E. J. Peltier, Chief of the Navy Bureau of Yards and Docks, cited three general categories: political, administrative, and technical. He told a Construction Division session that while technical problems may often be complicated, they are more determinable than administrative or political problems. The main concern of the Navy Civil Engineer Corps is to promote efficiency in design and construction without discouraging innovation, creativity, research, originality, and ingenuity in design and in construction practices. The system used involves delegating authority to senior field officers, each of whom has authority to award construction contracts. The result is a flexible operation with maximum efficiency in handling 125,000 structures with a replacement value of $19 billion scattered over 5,000,000 acres around the world.

Something New in Drydocks

Concrete pontoons with steel wing walls for floating drydocks is the big development in the ship repair facilities field, Comdr. H. I. Taylor, of the Navy Bureau of Yards and Docks, told a Waterways and Harbors Division session. Use of concrete pontoons reduces maintenance of the bottom of the dock and increases stability. Use of steel for the wingwalls and keeping them to a minimum width will permit operation without ballast. For a small dock a longitudinal T-shaped wing wall with machinery housed at the top seems a good design.

Bigger vessels from submarines upward have forced larger-size facilities for all craft. A proposed 1,740-ton marine railway for the Charleston, S.C., Naval Shipyard will have a divided cradle with sections 134 and 146 ft long. Either can dock a small vessel; together they can handle a 314-ft ship. Graving docks are being extended—a new one at Puget Sound (Washington) Naval Shipyard will be 1,152 ft long and 180 ft wide, to accommodate greater carrier widths, and provide 48-ft depth over 5-ft-high keel blocks.

Some of the members of the board of the American Sanitary Engineering Intersociety Board got together during the ASCE Convention in Washington. Pictured here are R. S. Rankin, Ray E. Lawrence, Blucher Poole, Thomas R. Camp, and R. J. Faust.

Two other Navy men told Convention sessions about unusual projects. Design and construction of "The Big Dish," a 600-ft parabolic reflector, is described by Capt. F. C. Tyrrell in a paper that appears on page 56 of this issue.

Commodore A. D. Hunter, USN (Ret.), of Washington, D. C., told how a test underwater launcher for the Navy's Polaris missile, which is designed for firing from nuclear submarines, was constructed on the ocean floor near San Clemente Island, about 60 miles off the coast of Southern California. Many problems confronted the engineers on the project. These included construction in deep water, working in the open ocean, the ever-present danger of storms and the logistic problems incident to working at a distance from the main base. This method involved the shoreside construction of a steel foundation form, a launcher base ring, and a base ring leveling frame as separate units. These components then were transported to the site, lowered into position, and embedded into the sand on the ocean bottom. A suction airlift was used to complete interior excavation of the caisson, and concrete placed by intrusion methods to fill the form and secure the case ring.

Recruitment of young engineers for the construction industry should start in junior high school and be actively maintained through college years, John E. Healy II, of Wilmington, Del., told a Construction Division session. We have a fine story to tell on the personal reward that comes from taking part in driving a tunnel, building a dam, raising a large building, or bringing civilization to a wilderness, said Mr. Healy. The Associated General Contractors of America has produced a film, "The Constructors," that is useful for school and parent groups. A query to contractors showed that 88 percent would like engineers trained in general management or planning construction operations and plant layout. The construction industry has much to offer the young engineer, said Mr. Healy. The pay is good, the work interesting, and the future bright. But more must be done to give young engineers this picture of the industry.

World-wide construction safety activities of the U.S. Army Corps of Engineers were described by Robert L. Jenkins. Native operators can be trained to do a good job, but all equipment must be guarded to prevent unauthorized use. Laborers will try to operate anything, frequently with disastrous results. In hot countries anything casting a shadow is a prize so it is a cardinal rule to look under machines before moving them. Chauffeurs tend to play Russian Roulette with cars at every intersection. Reaction to commendation for safe practices is very good. Most workers overseas are skilled in lifting; few back strains or hernias are reported. Shoes are not necessary, even in hot asphalt. Safety helmets sometimes are barred as turbans signify caste, tribe, or station in life.

Foreign Highway Improvements

"Amazing" is the word for the general status of foreign highway work, Robert O. Swain, executive director, International Road Federation, told a Highway Division meeting. The proportionate increase in road expenditures in foreign countries exceeds that of the United States, despite our spectacular interstate building program. Highway expenditures in the Free World countries, including the U.S., showed a 95 percent increase from 1955 to 1958, compared to 38 percent in this country. In 1958 total highway expenditures in the Free World totaled $17 billion, of which $10 billion was spent in the U.S.

Speaking on technical assistance given by the Bureau of Public Roads to foreign countries, F. C. Turner, deputy commissioner and chief engineer of the Bureau of Public Roads, commented: "If our purpose can be stated in a sentence, it is to aid a country in developing its own highway organization so it can develop a highway system that will in turn promote development of the national economy and thus the general welfare and prosperity of the people." The problems encountered vary from country to coun-

Eisenhower Lock on the St. Lawrence Seaway raises the U. S. Navy Destroyer "Ault." Note the tunnel for vehicular passage under the upstream gate of the lock. Papers on the Seaway were presented at the Convention by L. H. Burpee, of the St. Lawrence Seaway Authority of Canada, and M. W. Ottershagen, of this country's St. Lawrence Seaway Development Corporation.

try. The technological jump necessary may be 500 years. Progress may be from shovel and basket to bulldozer and earthmover without the long and gradual evolution through the slip-scraper, horse-drawn elevating grader, and steamroller that we ourselves passed through years ago.

Reporting on a preliminary study of stresses under off-road vehicles, John E. Green and S. J. Knight discussed tests at the U.S. Army Engineers Waterways Experiment Station, Vicksburg. The study does not necessarily involve conventional soil mechanics, which for the most part deals with deeper conditions. Surface soils have lower densities and can sustain higher moisture content than deeper soils. Thus they are much weaker than the soils normally considered. A vehicle traveling on such a soil will sink deeper and the soil itself will move appreciably. An interesting comment on wheeled vehicles is that below a depth of about 5 in. there seems to be no significant difference in the maximum stresses from tire pressures of 15 or 60 psi in a fairly soft fat clay.

In a paper on "Problems and Trends in Highway Financing," George M. Foster, executive director of the Indiana State Highway Department, commented that programs must be developed for each category of federal-aid, and first priority given to the current matching of those federal funds. Assurance on the part of the federal government is essential as to the extent of this financing. Further, financing must be arranged sufficiently in advance of its availability so that a continuing long-range program can be developed on a state-wide basis and the necessary lead time for the preparation of plans, acquisition of rights of way, and various sundry incidentals will be available. Programs must, and are, being developed on a continuing basis, keeping in mind that first needs must come first, but at the same time projecting each improvement so that within a reasonable time a road starts some place and goes some place.

Charles L. Dearing, executive director of the Illinois State Toll Highway Commission, Chicago, said that while the fatality rate per 100 million vehicle miles, in 1958, was 7.3 for state rural roads, the rate for toll roads was only 2.8. For all roads, including toll roads, the fatality rate was 5.6. During holiday weekends—Memorial Day, July 4, and Labor Day—of 1959, nearly 1,000 deaths took place on all other U.S. roads while there were only ten fatalities occurring on the toll highways. In 1950, the U.S. had only 424 miles of toll roads in operation, while in 1959 the toll road mileage had increased to a total of 3,103 miles, representing an investment of over $5 billion. Mr. Dearing advocated inclusion in the Interstate System of the features that have made toll roads popular.

Engineers attending a joint session of the Highway and City Planning Divisions heard Robert A. Keith discuss the financing and administration of the proposed transportation system for Washington, D. C. Mr. Keith, who is project director of the Mass Transportation Survey of the National Capital Planning Commission, told the group that for adequate facilities transportation expenditures in the future will need to be much greater than has previously been indicated. He said that the total system planned for Washington would cost about $2.5 billion or a little more than $100 million per year until 1980. This cost includes major street improvements as well as freeways and parkways, express transit facilities and downtown parking accommodations. Part of the funds for the proposed project will come from the Federal Government as well as from Maryland, Virginia, and the District of Columbia. Some of the facilities will pay for themselves while public financing might provide funds for other aspects of the program.

William R. McConochie, of De Leuw, Cather, Chicago, Ill., in discussing the national capital regional transportation study, said it was found that only 30 percent of the anticipated patronage of the proposed rapid transit system would be people who would otherwise have used their own automobiles. The rest would be those who would use local buses in the absence of rapid transit. The recommended solution for Washington is to build about $2 billion worth of freeways, parkways, major streets and parking facilities, together with half a billion dollars worth of rapid transit facilities, including 34 route-miles of rail lines and 66 route-miles of facilities for express bus operation on freeways.

Wilbur S. Smith predicted that the transit system would cut the number of peak-hour auto passengers to 100,000. In 1955 a total of 105,000 persons arrived at the peak hour by automobile. Passengers using rapid transit would number 55,000 in 1965 and reach as high as 75,000 in 1980. Local transit would carry about 15,000 in both years. The population of the region—1,568,000 in 1955—is expected to increase to 2,390,000 by 1965 and 3,000,000 by 1980.

In 1955, nearly 2,500,000 trips were made in cars and 640,000 trips, or about 20 percent of the total, by transit. Without improvements, he said, trips by transit would decrease to 17.2 percent by 1965 and 14.3 percent by 1980, while trips by automobile would mount up to more than double by 1980. Between 1948 and 1955, despite a rapid population growth, overall use of public transit declined about 17 percent. The number of taxi trips increased about six percent during the period, although the cabs in service in 1955 were about 15 percent more numerous than in 1948. In 1940, 42 percent used private autos. Today, 70 percent drive to work.

Building New Airfields

James H. McLerran, of the Corps of Engineers, told a session of the Air Transport Division that information used to select sites for airfields can be obtained in many ways, namely topographic maps, geology, and field data. However, he continued, airphoto interpretation gives the engineer a perspective that none of these other methods

can. With airphoto interpretation, the engineer is able to make a comprehensive evaluation of all the environment factors that enter into the analysis. Airphotos, Mr. McLerran said, should be used at the start at the first planning stage and continue hand in hand with all other planning and investigations.

At the same session Comdr. E. H. Sheridan, U.S. Coast and Geodetic Survey, reviewed the contributions of that organization to air transport. He stated that, in addition to the compilation and maintenance of current charts and the constant study and planning to cope with ever-changing requirements, the Bureau will continue to produce special projects in the interest of aviation, such as star curves and different projections at various scales.

Engineers attending another session of the Air Transport Division were told that the rapid development of both military and commercial aviation, with increased loads, has posed many structural problems in the design and construction of adequate pavements. A paper prepared by W. C. Simpson, H. J. Sommer, R. L. Griffin, and T. K. Miles revealed that epoxy asphalt concrete has emerged as a material well suited to solve simultaneously the problems of heavy loads, high temperature and velocity blast, and fuel spillage. The paper stressed that the successful use of epoxy asphalt concrete requires proper handling of the graded mineral aggregate and Epon Asphalt binder in the mix plant and during the laying operation.

Surveying and Mapping

There are major civil engineering improvements under consideration for Alaska that will require a lot of surveying and mapping. Already being investigated are a 45,000-kw power plant at Devils Canyon on the Susitna River, between Anchorage and Fairbanks, and a 65,000-kw plant which will serve Juneau, said Lansing G. Simmons, of the U.S. Coast and Geodetic Survey, Washington, D. C., at a panel discussion on surveying and mapping problems of the two new states, Alaska and Hawaii. But more important is a proposal for a billion-dollar Yukon River project, which would impound a reservoir larger than Lake Erie and supply 5,000,000-kw of power. High-grade control surveys and large-scale mapping required for these projects alone could use a significant portion of the surveying and mapping talent in the United States for a number of years, he remarked.

Alaska, with its many challenges to mapmakers in the form of terrain, weather, and logistics problems, has been an opportune proving ground for the development of new and enterprising mapping techniques, stated Reynold E. Isto, of the U.S. Geological Survey, at Fairbanks, Alaska. At a session of the Surveying and Mapping Division he stated that the chief innovation of recent years has been the use of air transportation, particularly helicopters. Since 1948, Mr. Isto continued, virtually all Alaskan topographic mapping has been carried out by compilation from aerial photographs. Compilation has been accomplished mostly with multiplex and ER-55 stereoscopic plotting instruments.

Present surveys of public domain in Alaska amount to less than 1 percent of the total area of the state, Franklin K. Van Zandt, of the U.S. Bureau of Land Management, told the Convention in talking about "Cadastral Surveying Problems in Alaska." Small areas around lakes and along highways, in demand for recreation or small business use have been surveyed, but a large number of these are necessary to add an appreciable amount to the total area. Cadastral surveys are usually conducted in advance of local improvement, so lack of roads and living accommodations calls for use of the airplane and helicopter with the new methods of photogrammetry, the tellurometer and other modern tools.

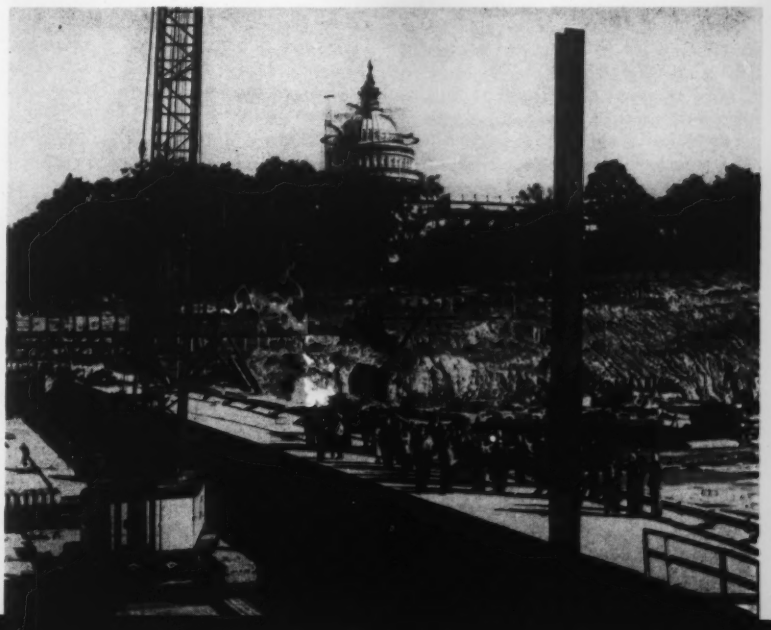
Land subsidence over an area is difficult to measure because of possible general movement of a large area, Capt. J. H. Brittain, chief of the Geodesy Division of the U.S. Coast and Geodetic Survey, told another surveying and mapping session. One means of providing a dependable reference is driving a ⅝-in. copper-coated steel rod to refusal with a 90-lb gasoline hammer slung from a pipe tripod. Successive 8-ft rod sections are joined by brass couplings to reach depths as great as 100 ft. At other times lines are run some distance to bedrock outcrops. Some areas in California and Texas have settled many feet and are continuing to move. Settlement induced by impoundment of Lake Mead above Hoover Dam was found to be 0.4 ft.

Soil Mechanics of Capitol Hill

Despite being far in advance of soils mechanics technology, the builders of the Capitol in Washington did a commendable job, W. H. Mueser, partner in the New York firm of Moran, Proctor, Mueser and Rutledge, told the meeting. Mr. Mueser made an investigation of foundations under the building in connection with design of the new facade being put on the structure. There is little record of any soils investigations at the site, but by current standards the foundations for the building are adequate without being over designed. The Capitol rests on spread footings on a gravel and clay soil. There has been very little differential settlement in the more than 160 years since the start of construction.

Soil conditions are not so good a few hundred feet away at the site of the additional House of Representatives Office Building, said George F. Sowers, professor of civil engineering at Georgia Institute of Technology, in a paper prepared with Gordon V. Dalrymple, of Law Engineering Testing Company, Atlanta. The foundations are unusual because of the size of the structure, the difference

Tours of the Nation's Capital were an important Convention week feature. Here a group of ASCE members is shown at the construction site of House Office Building No. 3. Other projects on the tour agenda were the reconstruction of the Capitol (shown in the background), the new State Department Office Building, Dulles International Airport, the atomic reactor at Fort Belvoir, and the sewage treatment plant for the District of Columbia. Photo courtesy of Bethlehem Steel Co.



in ground surface level from one end of the site to the other, and the relatively poor soils immediately beneath the lowest level of the building. The substructure consists of a concrete box, supported by 50-ton piles driven into dense silty and clayey sands 40 ft below the lowest floor. Hydrostatic uplift from high groundwater table is overcome by a combination of structural weight, a heavy mat, tension piles and drainage. Part of the lateral load resulting from a high ground surface at one end and low level at the other is resisted by transverse shear lugs made by deepening portions of the foundation. The 720-ft-long, 450-ft-wide substructure will include three basement garage levels, a sub-basement and a basement. The hillside site has a difference in elevation of more than 40 ft.

Sanitation Problems to the Fore

Speaking on "Sanitary Engineering Aspects of Metropolitan Problems" at a Sanitary Engineering Division meeting, Wesley E. Gilbertson, chief, Division of Engineering Services, U.S. Public Health Service, Washington, commented that large concentrations of men and their machines cause special difficulties in periods of rapid growth and change. Health and sanitation problems of our modern cities are once more taking ascendancy said Mr. Gilbertson. "In our technical design work we utilize the best available data on future requirements and compute the capacities to take care of expected needs. We do our best to build for tomorrow. But when we analyze the economic factors, we generally use today's figures, or even worse, yesterday's." Improved data collection and evaluation could accelerate needed public policy changes in water, sewerage and related areas. For example, it might be logical to incorporate underwriting of public sanitary systems into housing loan programs. The gap between the two is now a major deficiency. As a solution, the speaker suggested an annual forum or symposium on urbanization or metropolitanism. Co-sponsors might include ASCE and associations with related interests—such as water works, sewage, and municipal—with federal, state and local officials and academic institutions. He concluded, "Were the ASCE to take the first step, it would give a clear indication that the civil and sanitary engineering groups feel that they have real professional contributions to make."

Alfred A. Estrada reported on a study made on the design and cost considerations in the use of high-rate sludge digestion. After gathering and studying material from equipment manufacturers and plant operators, Mr. Estrada concluded that there are sufficient data available to demonstrate the effectiveness and the possibility of a reduction in capacity through the use of gas recirculation for the vigorous agitation required for high-rate digestion. He went on to say that a conservative interim criterion for the design of high-rate digestion tanks should be adopted.

District of Columbia residents must be patient and not expect conclusive results right away from the additional facilities being added to the District of Columbia sewage treatment plant, its superintendent, Hugh A. Schreiber, told another session. Mr. Schreiber said that the additional sewage treatment facilities are being designed for a population increase to 1,791,000 by 1980. The municipal growth and the increased tributary population served by the District Sewage Treatment Plant from Maryland and Virginia, has made it necessary to expand plant facilities to treat 240 mgd, a twofold increase over the original plant design. It is incumbent on the District to approach future plant expansion on the basis of making more efficient use of existing facilities, as well as the installation of secondary treatment.

Hydraulic Models Improved

Over the past few years hydraulic models have developed from crudely built and operated models which produced somewhat unreliable results to precisely constructed electronically operated models producing reliable and accurate results. In discussing fixed-bed river models on a Hydraulics Division program J. E. Foster, of the Waterways Experiment Station, at Vicksburg, Miss., stated that the models bridge the gap between abstract theory and practical design. The use of models to obtain a preview of the behavior of the prototype under various conditions has become an integral part of the design of hydraulic structures and the development of river improvements.

What the Board Did in Washington

Indicative of the greater service ASCE is rendering to its members the ASCE Board of Direction, at its Washington meeting, approved a **record $1,789,600 budget** for the 1960 fiscal year, compared to $1,600,000 spent last year. This will provide over $100,000 more for improved technical publications, money for professional practice activities, for younger member services, and other essentials. Additional income is expected from the expanding membership and from greater sales of advertising in CIVIL ENGINEERING.

This was one of several outstanding actions taken by the Board during the Washington Convention. Another important decision was to approve making a **group life insurance policy available** to members of ASCE. Cost and benefits are given in a separate item in this issue. Details of "The New Look in Technical Publications," approved by the Board, also appear elsewhere.

Prizes Awarded

The Board of Direction approved the **award of five research prizes** for 1959. The winners are announced in a separate Society News item.

The Board voted to accept the recommendations of the ASCE Committee on Prizes for award of the **1959 Daniel W. Mead Prizes.** The winner of the Associate Member Prize is Morgan I. Doyne, civil engineer for the Ben Hur Construction Co., of St. Louis, Mo. The Student Chapter winner is Earl G. McLaren, of the University of California, Berkeley. Both wrote on the same subject, "The Responsibility of the Employee Engineer to His Employer." If convenient to the recipients, presentation of the prizes to them will be made at the New Orleans Convention.

Professional Prize Established

The Board accepted an $8,000 endowment from **Edmund Friedman** of Miami, former Director and Vice-President of the Society, **to establish a prize** that will recognize "outstanding professional activity." It is hoped that the prize will increase interest in and recognition of endeavors that advance ASCE professionally. The as yet unnamed prize will be featured in a forthcoming issue of CIVIL ENGINEERING.

In recognition of long association with and intimate knowledge of the Society, as well as his experience with Engineers Joint Council, the Board elected as **Treasurer E. L. Chandler,** Assistant Secretary ASCE. Enoch R. Needles continues as Assistant Treasurer.

For Younger Members

Continued **encouragement of younger members** was shown by several actions

of the Board: Approval was given to the recommendation of the Committee on Younger Members to change the term "Junior Member Forum" to "Younger Member Forum"; attendance of an additional Associate Member under 35 from each Local Section at Local Section Conferences was authorized unless the official Section delegate is an Associate Member under 35; attendance of a member of the Committee on Younger Members at Local Section Conferences was provided for.

Interest in students was shown by Board authorization for two Faculty Adviser Conferences this year in addition to one held in connection with the Washington Convention. About three such conferences are planned for each succeeding year to stimulate student activity.

Redistricting

The Committee on Districts and Zones presented **three basic plans for geographical rearrangement** for consideration by the Local Sections and Branches. No change in the number of Directors is foreseen. The Board concurred that the full plans should be sent soon to the Local Sections and Branches for comment and return to Executive Secretary Wisely before March 15, 1960.

Future Conventions

The Board approved locations for **1964 Conventions:** Cincinnati in February or March, Salt Lake City in May or June, and New York City in October. Previously approved locations are: 1960, New Orleans, March 7-11; Reno, June 20-24; Boston, October 10-14. 1961, Phoenix, April 10-14; New York, October 16-20. 1962, Houston, Omaha, and Detroit; 1963, Atlanta, Milwaukee, and San Francisco.

Concerning Conventions the Board voted to seek a more economical means of publicizing attendance than the present mailing to every member at a cost of $1,500. It also reaffirmed the policy of prohibiting the use of funds of the Society for support of cocktail parties at Conventions or conferences. (Traditionally this has been handled by the Local Sections.)

The Code of Ethics

Publication of the **report of the Task Committee on Principles of Practice** was authorized and the committee discharged. The report consists of an interpretation of the Code of Ethics and a description of the client-engineer relationship. This statement has had considerable attention from many in the Society and will clarify professional ethics. Some editing was directed, after which the material will be available to supplement Manual 38, "The Private Practice of Civil Engineering."

A number of cases of **alleged violations** of the Code of Ethics were brought before the Board. Investigation showed that ten of them were not sustained by facts and they were dismissed. Several were deferred until further information can be obtained. One member will be invited to appear before the Board of Direction at New Orleans to present his side of what seems to be a serious violation of the Code of Ethics for a member of the Society.

Liaison with Technical Divisions

In a effort to create **stronger liaison** and better communication **between the Board of Direction and the Technical Division,** the Executive Committee voted to assign two Technical Divisions to one Director, the Director being a member of the Division Activities Committee. In the past there has been a Board Contact Member for each Division but he was consulted only for special action. Now Executive Committee meetings will be planned to include attendance of the Board Contact member, who will have voting privileges.

Engineers in Federal Service

Congress is currently concerned with the degree to which **consulting engineering services** are being employed in **federal public works agencies.** Because of large numbers of ASCE members in public agencies and consulting firms, the Board of Direction instructed the Executive Secretary to prepare a suitable statement for appropriate presentation to any Congressional group considering this subject. Such statement would be cleared by the Executive Committee of the Society.

Other Board action included the **discharge of the Task Committee on Cost Allocation of Multiple Purpose Water Projects.** Its functions were transferred to the Liaison Committee regarding EJC National Water Policy, a standing committee formerly called the Task Committee Advisory to the EJC National Water Policy Panel.

Approval was given to the **proposed amendments to the charter of Engineers Council for Professional Development.** These amendments are desired to facilitate the approval of the exemption that is sought under Section 501 (*c*) (3) of the Internal Revenue Code.

Civil Defense Coordinating Committee

Civil defense also received the attention of the Board in the form of authorization of the creation of a Coordinating Committee on Civil Defense. The purpose of this committee is to stimulate and coordinate the activities within the Technical Divisions related to civil engineering aspects of civil defense. The committee will consist of five members appointed by the Committee on Division Activities, upon the recommendation of the Air Transport, City Planning, Construction, Sanitary Engineering, and Structural Divisions, the chairman to be selected from these appointees.

For Metric System—Since 1876

Reaffirming a statement of policy which was adopted by the Society in 1876, the Board stated the **present policy of ASCE on the metric system of measurements** is "to further by all practical and appropriate means, the adoption of the metric standards of weights and measures in the United States of America."

National Highway Program Endorsed

On recommendation of the Highway Division, the incoming Board of Direction adopted the following resolution: "The American Society of Civil Engineers in Convention assembled this 22d day of October 1959 hereby affirms its support of the **national highway program** as established, and its continuance without major alterations. The Society urges that the reviews (of the basic concepts, progress, and administration of the program now to be made by the Executive Branch of the Federal Government and by a Committee of Congress) be conducted with the full advice and counsel of qualified highway engineers and be guided by engineering facts and economic considerations to the end that the program may achieve its full potential in serving the economy, the national defense, and the safety and welfare of the American people."

Five Engineers Win ASCE Research Prizes

Nominations for the ASCE Research Prizes for 1959 made by the Society's Committee on Research were endorsed by the Board of Direction at its Washington meeting. This year's winners are Charles L. Bretschneider, M. ASCE, hydraulic engineer, Beach Erosion Board, Washington, D.C.; Norman Brooks, M. ASCE, associate professor of civil engineering, California Institute of Technology, Pasadena, Calif.; Arthur Casagrande, F. ASCE, Gordon McKay Professor of Soil Mechanics and Foundation Engineering, Harvard University, Cambridge, Mass.; Daniel Frederick, A.M. ASCE, professor of engineering mechanics, Virginia Polytechnic Institute, Blacksburg, Va.; and George S. Vincent, F. ASCE, chief, Bridge Research Branch, Bureau of Public Roads, Washington, D.C. Presentation of the prizes to the five winners will take place at the Society's New Orleans Convention.

The prizes were established in 1946 to stimulate research in civil engineering. Each award consists of $100 and a suitable certificate.

Herbert Hoover Breaks Ground for United Engineering Center

The engineering profession took a historic step on October 1, when ground was broken on United Nations Plaza in New York for the long-dreamed-of United Engineering Center. The eighteen-story, multi-million-dollar structure, the most impressive home yet provided for the headquarters staffs of the engineering societies, attests to the rapidly growing strength and importance of the profession.

Earth-turning honors were shared by former President Herbert Hoover, representing the older generation of engineers, and Jerry Fujimoto, a freshman engineering student from Hawaii, representing the future generations. Despite overcast skies and occasional rain, there were over 1,000 at the ground breaking including a number of foreign engineers. Representatives were present from the engineering societies of Australia, Belgium, Canada, Germany, Great Britain, Brazil, Portugal, and Puerto Rico.

Andrew Fletcher, president of United Engineering Trustees, which will operate the Center for the engineering societies, presided at the ceremonies. He said that the new Center, in addition to its primary purpose of providing adequate working space for the headquarters staffs, "will symbolize the growing strength and growing unity of the engineering profession."

In the featured talk, Mr. Hoover commented that, "The engineering societies are in reality a great educational institution. Within the societies is the constant exchange of discovery, improvements and experience. Their findings are printed for all the world to see.

"These societies also constitute a gigantic postgraduate course for engineers, which will continue all their professional lives. I have attended this course for more than sixty years with intellectual profit.

"I have said before now that the job of the engineer is to take from the scientists their discoveries and from the inventors their findings, and to apply them for the use of the people everywhere. The engineer starts with these stimulants to his imagination. He makes a plan on paper. Then he moves to its realization in cement, in metal, in stone, and in energy. Thus he brings jobs and better homes. This is high privilege among all professions.

"The purpose of this great building is to facilitate these goals. It will play a great part in American life. It will serve all mankind."

The other speakers were Willis F. Thompson, chairman of the UET Real Estate Committee; R. E. Dougherty, Past-President of ASCE and chairman of the Member Gifts Campaign Committee; and Mervin J. Kelly, chairman of the Industrial Building Fund Committee.

Sign on United Nations Plaza, between 47th and 48th Streets, proudly proclaims it the site of the United Engineering Center.

All three speakers stressed the fact that much is yet to be done, particularly in the field of fund raising. Mr. Kelly, whose industrial campaign has collected almost $5 million, took the occasion to thank the "more than 500 corporations and 56,000 engineers and friends of engineering whose contributions have been sufficient to warrant the start of construction." Mr. Dougherty stressed the need of more member participation in the fund raising. "We are hopeful," he said, "that there will be at least 200,000 contributions."

Said Mr. Thompson, "the new Center will incorporate every advanced feature and facility that the architectural and engineering professions can provide. . . . To engineers," he concluded, "this structure will symbolize recognition of the great responsibilities borne by the profession. To those young men who have yet to choose an engineering education it will give inspiration. To our people who depend so much on the engineer to maintain our way of life, our security, and our freedom, it will be a flaming beacon of faith and hope."

Plans for the Center have been over eight years in the making. The site on United Nations Plaza, between 47th and 48th Streets, was acquired in 1957. Since then the major efforts of UET have been directed toward the design of the building and fund-raising activities. It is expected that the structure—a slim tower of glass, metal and limestone rising from a two-story base—will be ready for occupancy in mid-1961.

Shreve, Lamb and Harmon Associates are the architects. The structural engineers are Seelye, Stevenson, Value & Knecht, and the mechanical and electrical engineers are Jaros, Baum & Bolles. The general contractor is the Turner Construction Company.

Former President Herbert Hoover and Jerry Fujimoto, Rensselaer freshman engineering student from Hawaii, break ground for the United Engineering Center. At right is Andrew Fletcher, president of UET, and at left J. H. Foote.

UEC HONOR ROLL

The ASCE drive for funds in the campaign for the United Engineering Center is gaining momentum in the Local Sections. Three more Sections—Maryland, Tennessee Valley, and Metropolitan—have met their quotas since the UEC Honor Roll was last published (October issue). Four other Sections—Rhode Island, Maine, Connecticut, and Nebraska—are on the home stretch with over 90 percent of their goals attained. Once again we list the successful Sections—twenty-four of them this time—in the order in which quotas were met. The figures at the right indicate percentages as of October 16.

Kentucky (110)
Lehigh Valley (136)
Nashville (103)
Cincinnati (141)
Columbia (127)
Philadelphia (140)
Hawaii (119)
Rochester (123)
Ithaca (121)
Southern Idaho (166)
Indiana (135)
Delaware (105)
Kansas City (109)
Central Pennsylvania (108)
Arizona (108)
West Virginia (124)
Central Ohio (103)
Tri-City (105)
Puerto Rico (113)
Wisconsin (102)
Georgia (102)
Maryland (104)
Tennessee Valley (100)
Metropolitan (102)

An Open Letter to All Members of ASCE

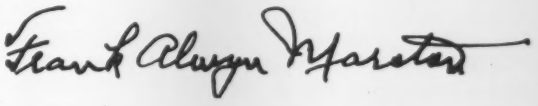
As one of my first official acts upon assuming the presidency of ASCE, this will record my determination to continue the emphasis accorded by Past-President Friel to the United Engineering Center campaign. The drive will be continued throughout the Society until the entire $800,000 quota is pledged.

About a half-million dollars was contributed by our members under Mr. Friel's dynamic leadership. There remains, however, about $165,000 to be raised to fulfill the ASCE quota. With 33,000 members who have not yet participated, to raise this amount should not be difficult.

I urge the Local Sections to continue the pursuit of the campaign with all diligence, until the Society meets its responsibility completely. The successful consummation of this project is vitally important to the prestige of ASCE.

I am counting upon all of you to sustain the effort that has brought us so close to our goal. Just a little more of the same hard work will add another notable accomplishment to the record that has given our Society its greatness.

Sincerely yours,



President

Campaign in ASCE Sections

The Champs

Local Section	Quota %	Local Section	Quota %
South Idaho	166	Kansas City	109
Cincinnati	141	Arizona	108
Philadelphia	140	Central Pa.	108
Lehigh Valley	136	Delaware	105
Indiana	135	Tri-City	105
Columbia	127	Maryland	104
West Virginia	124	Central Ohio	103
Rochester	123	Nashville	103
Ithaca	121	Georgia	102
Hawaii	119	Wisconsin	102
Puerto Rico	113	Metropolitan	102
Kentucky	110	Tenn. Valley	100

Down the Stretch

Rhode Island	99	San Francisco	88
Maine	97	Tacoma	85
Connecticut	96	Texas	79
Nebraska	91	Massachusetts	78
Central Illinois	89	Syracuse	74
Illinois	89	Sacramento	72
Iowa	89		

Gaining Speed

Mid-Missouri	70	Cleveland	55
Panama	70	Mohawk-Hudson	53
Seattle	69	San Diego	51
Kansas	68	Toledo	50
Spokane	68	Los Angeles	48
Pittsburgh	67	South Carolina	48
St. Louis	66	Intermountain	47
Duluth	65	Montana	47
Buffalo	63	Venezuela	47
Dayton	63	Nat'l Capital	46
North Carolina	59	Virginia	44
Mid-South	59	Miami	41
Oklahoma	59	Alaska	41
Akron	57	Oregon	41

Slow Start, Strong Finish?

New Mexico	38	Florida	29
Northwestern	38	Wyoming	29
Louisiana	35	South Dakota	28
Mexico	35	Alabama	25
Michigan	35	Brazil	14
Colorado	34	Rep. Colombia	10
New Hampshire	32		

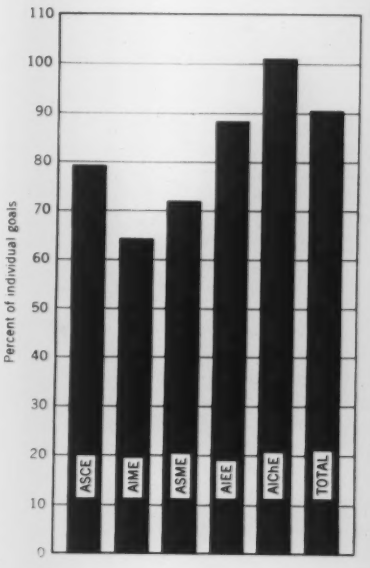


Fig. 1. Member giving for United Engineering Center as of October 16. ASCE giving takes dramatic upward spurt in recent weeks to almost 80 percent of its goal.

Ford Foundation Gives $19 Million to Spur Engineering Education

The Ford Foundation has made the first major grants in its new program in science and engineering. The grants, which are aimed at the advancement of engineering education, total $19,050,000 and will go to ten institutions in the United States. Announcement of the grants was made on October 20 by Henry T. Heald, F. ASCE, president of the Ford Foundation, in a featured address before the annual dinner of the American Institute of Consulting Engineers, held in Washington during the ASCE Convention.

"In the last two decades, a revolution has been under way in the practice of engineering," Dr. Heald said. "Yet engineering education—the gateway to professional practice—has lagged behind.

"In a hopeless race against time and reality, most engineering students in their late teens and early twenties are being equipped for the engineering of the last half of the twentieth century by being indoctrinated with the art and practice of the 1950's."

Dr. Heald urged that engineering education impart "a thorough understanding of science and mathematics, their frontiers, and how they may be applied to the needs of mankind."

The Foundation's grants in engineering education, he said, are aimed at two objectives:

- To support promising plans for development of and experimentation with imaginative educational programs.
- To help develop and further excellence in engineering faculties, both by additional training of present faculties and by recruiting and development of increased numbers of well-trained engineering teachers."

The recipients of Foundation grants are:

Massachusetts Institute of Technology	$9,275,000
California Institute of Technology	3,200,000
Carnegie Institute of Technology	2,250,000
University of California (Los Angeles)	1,200,000
University of Michigan	1,175,000
Case Institute of Technology	1,000,000
University of Illinois	275,000
Purdue University	275,000
Stanford University	200,000
University of Wisconsin	200,000

New Program for ASCE Technical Publications

The ASCE Board of Direction has endorsed important changes in the Society's Technical Publications program. These changes, long under study by the Committee on Publications, will go a long way toward improving the appearance and status of the publications.

As a first step, the Technical Divisions have been requested to improve their reviewing procedures to allow for no less than two reviews to either accept or reject a paper. Also, each reviewer will be required to give a numerical grade to the paper. If the number of papers awaiting publication at any one time is excessive, the grades will be used to determine which papers should be rejected because of lack of space.

The Technical Publications department has been given the duty of editing for general and policy standards, working with the authors at this stage. Illustrations will also be adjusted, where necessary, to improve the clarity and save space. Beginning with the January journals, the printer will set all mathematics, tables, and figure captions in a uniform fashion. In addition, the right-hand margin of the text will be aligned.

Transactions will also be affected by decisions reached by the Committee on Publications. Beginning with the 1961 issue (Volume 126), the Transactions will be reproduced from the same material used to produce the Journals. That is, no adjustments will be made in the stage from Proceedings to Transactions other than the collating of the paper, discussion, and closure and the correction of any errors. The criterion for choosing papers to appear in Transactions will be liberalized to allow for the inclusion of all Journal papers that elicit worthwhile discussion.

1960 ASCE Research Fellowship Available

The ASCE Research Fellowship Prize—established by the Board of Direction in 1958 and awarded for the first time in 1959—is open for 1960. Applications must be received at Society Headquarters prior to January 1, 1960, and the applicant will be selected before March 15. Six copies of each application are required. There is no set application form. Applicants must be members of the Society in any grade, citizens of the United States, and graduates from an accepted curriculum.

The grant, which is made annually, amounts to $5,000. The current award will be for a twelve-month period beginning not later than October 1, 1960. The Research Fellow is required to devote full time to his proposed research during the tenure of the fellowship, and he must submit a report on his work to the Executive Secretary on completion of his year of research.

Selection for the award of the grant will be made by the Committee on Society Fellowships, Scholarships, Grants and Bequests on the basis of the following:

1. Transcripts of scholastic records.
2. Ability to conceive and explore original ideas (letters of recommendation will be considered only when they contribute specific information on this ability).
3. Description of proposed research and its objectives, including a statement from the institution at which the research is to be done that the applicant and proposed research are acceptable to the institution. Preference is given to research that is basic in nature and concept, rather than applied, developmental, or designed to extend or elaborate information. Research requiring an extensive testing program will not be considered.

Junior Engineering Technical Society

One of the hopeful developments in the nation's long-range program to stimulate interest in engineering and science among high school students is the success of the Junior Engineering Technical Society, called "JETS." Founded at Michigan State University in 1950, the JETS movement spread rapidly throughout the state and then across the country. Currently there are over 350 chapters in 41 states and Puerto Rico. The newly constituted board of JETS (including the president of Engineers Council for Professional Development and the chairman of the Engineering Manpower Commission of Engineers Joint Council) has now voted to set JETS up as an independent national organization.

In addition to providing an opportunity for those with aptitudes for science and mathematics to prepare themselves for engineering or scientific careers, the JETS program helps the student appraise his own abilities and interests. The high school science teacher acts as sponsor of the local chapter, and the group receives

counseling from engineers in the community. A weekly newsletter, "JETS-O-GRAM," issued from the headquarters office at East Lansing, lists scholarships and prizes available and keeps groups in touch with each other.

Group Life Insurance Bargain For Members

The Board of Direction at the Washington Convention authorized making available group life insurance to members of ASCE in what appears to be a very advantageous offer. For annual payments of $50 for those under 30, or $100 for those over 30, the amounts shown in the accompanying tabulation are payable at the indicated age at time of death.

The firm of Smith and Sternau, which now administers the ASCE Group Disability and Hospitalization Program, will handle the life insurance. It will be underwritten by New York Life, a mutual company, which will pay dividends when a reserve is accumulated. There will be no personal solicitation. Promotion will be by mail only with a requirement that 500 must enroll in six months to put the plan in force initially.

ASCE representatives who have studied the plan feel it is an excellent proposal. It offers very high coverage at low cost to younger members at a time when it is especially important.

Age	$50 Annual Contribution	$100 Annual Contribution
20	$15,750	
22	15,750	
24	15,750	
26	15,120	
28	13,860	
30	12,600	
31		24,120
33		21,960
35		19,800
37		17,640
39		15,480
41		13,590
43		11,970
45		10,350
47		9,090
49		7,830
51		6,750
53		5,850
55		4,950
57		4,230
59		3,510
61		2,970
63		2,610
65		2,250
67		1,890
70		1,350

A general mailing to members, sometime in December, will give all the details.

San Francisco Section Seeks To Reduce Construction Cost

More than 1,600 Bay Area civil engineers are taking part in a San Francisco Section survey aimed at finding ways of reducing spiralling construction costs. The Survey is being carried out by the Section's Construction Division, which has mailed questionnaires to the entire Section membership. The inquiry seeks to discover the most efficient and economic engineering and administrative procedures employed by the engineers who direct the booming construction business in the San Francisco area. It is probing every aspect of the construction field from bidding practices and methods of awarding contracts to bonus payments for early completion of projects.

The survey is headed by a seven-man group of Section members, under the chairmanship of Charles T. Blair, vice-president of Wilsey and Ham, Engineers and Planners, Millbrae, Calif. Mr. Blair pointed out that such a survey is particularly important in the Bay Area, where the cost of living is the highest in the nation. "Someone must take the lead in attempting to control the causes of this vicious inflationary spiral," he said. "We hope that in some measure our efforts will help."

The results of the survey and an analysis will be available later.

Washington Local Sections Aid State in Water Study

The development of water resources is an important part of the work of civil engineers in the State of Washington. In a successful joint action three ASCE Local Sections—Seattle, Spokane, and Tacoma—have been instrumental in getting the state to launch a needed study of its water resources. During the 1959 session of the Legislature radical modification of the state's basic legislation relating to water rights, weather modification, pollution, and water resources development was proposed. After careful review of the proposed new legislation, the three Sections recommended that a study be made of the state's entire water picture before enactment of any new legislation. The ultimate aim of the study would be the development of a state water policy.

The three Sections also recommended formation of a special technical task force, representative of all the state interests concerned, to make such a study, compile a report, and make recommendations for the means of implementing and administering a state water policy.

As a result of these suggestions, the proposed new legislation was deferred and a fifteen-member Water Resources Advisory Committee set up to advise the Washington State Legislative Council. Lawrence E. Hall, assistant to the operating manager of the Puget Sound Power & Light Company and chairman of the Water Resources Committee of the Seattle Section, was elected chairman of the new Advisory Committee at its first meeting on October 3. The Seattle and Tacoma Sections are represented jointly on the committee by Roy W. Morse, city engineer of Seattle. The Spokane Section is represented by Gilbert H. Dunstan, professor of civil engineering at Washington State University.

The success of the three Sections in their combined effort to secure better water legislation for the state is encouraging, indeed, to those who advocate a broadened role for the engineering profession.

Invitation to New Orleans—for ASCE Spring Convention

Acting Mayor Victor H. Schiro of New Orleans (center) formally invites ASCE to his famous city for its next Convention—March 7-11, 1960. Acting for ASCE are General Convention Chairman Roy T. Sessums (left) and Bernhard Dornblatt, new Director for District 15.

The Younger Viewpoint

Committee on Younger Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 510 Millburn Ave. Millburn, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	Walter D. Linzing 4751 No. Paulina Chicago 40, Ill.	Rodney P. Lundin 9744 Quakertown Ave. Chatsworth, Calif.

Walter D. Linzing representing Zone III is the reporter for this issue.

Engineering Education

Continuing a discussion on which several interesting opinions have been received is a letter sent to Albert C. Nelson, reporter for Zone II. Earl J. Kramer, A.M. ASCE, Supervisor Structural Engineer, U.S. Corps of Engineers, Mobile District Office, writes in part:

"I agree with Peter G. Hoadley [writing in "The Younger Viewpoint" for August] that the engineering curriculum needs to be expanded. The present four-year course has not kept pace with our technological growth. More basic science and mathematics courses need to be offered, for it is these courses that form the foundation for all future study. The liberal arts courses have been systematically eliminated from engineering curricula with tragic results. This trend needs to be reversed. I believe the engineer's lost prestige has been the result of his inability to communicate with his fellow professionals and the public.

"However, increasing the course to five, six, or seven years will not be easy. A longer course will place the engineering profession more in competition with the medical or law professions for new blood. The high school senior, who desires to be more than a technician and has professional ability, will no longer have as wide a selection of fields which would best fit his time schedule. Are the private or government engineer-employing agencies, ready, willing, or even able to meet the competition? Present monetary remuneration and employer-employee relations will need to be adjusted, in some areas rather drastically, to maintain the engineering profession in a favorable position and also to compensate for the longer period of time spent in preparation."

Kansas Section—Thank You

The Kansas Section in its monthly Newsletter carried an appeal for letters and comments from the membership for use in "The Younger Viewpoint." If other Sections will give us similar assistance this column will be able to present a wider cross section of the opinions of the membership. Thank you, Kansas Section!

Wisconsin Section Picnic

This year 160 engineers and their friends and families attended the Wisconsin Section's annual picnic—how many other Sections can boast this type of activity?

Outstanding Young Engineer?

Engineers, has it ever occurred to you that some young engineer may well deserve to be nominated as one of the nation's Ten Outstanding Young Men.

How about working on this for the 1960 nominations to the U. S. Jaycees. Contact your local Junior Chamber of Commerce on this. Let's get some deserved public recognition for an up-and-coming young engineer.

And finally, the Engineer's Council for Professional Development suggests that you ask yourself:

"Am I doing my part to maintain conditions of mutual respect and cordiality in the organization component of which I am a part? Are my understanding of responsibilities, the quality of my work, and my overall attitude as seen by others, such as to promote these desirable conditions?

"What are my responsibilities to the other members of my profession? What service do they have a reasonable right to expect of me?

"Am I taking advantage of the benefits offered to me through the professional societies by others of my profession?"

Ground Rules: Please submit your idea, question, blast or pat on the back in terse letter form to your appropriate Zone editor. We will publish it with full credit and supply answers where possible.

ASCE Clubs Recommended

In a recommendation to the Board of Direction, the Committee on Student Chapters has proposed that official ASCE Clubs be permitted at engineering schools of non-ECPD-accredited status, provided graduates of the schools are eligible for the Engineer-in-Training certificate. It is believed that the ASCE Clubs would stimulate interest in civil engineering, professional development, E.I.T. examinations, and ASCE. Among the privileges that would be granted to these clubs would be a reduced subscription rate ($2.50) to CIVIL ENGINEERING and copies of the Student Chapter Handbook to be used as a guide.

Other actions taken by the Committee, at its meetings in Washington last month, included a vote to accept application from UCLA for formation of a Student Chapter at that school, bringing the total number of Student Chapters to 138.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.13	1.13
Baltimore	1.14	1.12
Boston	1.22	1.18
Chicago	1.43	1.36
Denver	1.21	1.21
Houston	1.26	1.26
Kansas City	1.16	1.11
Los Angeles	1.23	1.21
Miami	1.57	1.57
New Orleans	1.18	1.03
New York	1.28	1.25
Pittsburgh	1.04	0.95
Portland (Ore.)	1.25	1.16
San Francisco	1.24	1.24
Seattle	1.06	1.06

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	0.90	0.92
II, Mid Atlantic	1.14	1.13
III, Mid West	1.22	1.16
IV, South	1.14	1.08
V, West	1.03	1.02
VI, Far West	1.13	1.11

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current salary total for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930. This is the total of salaries paid in 1956 for the equivalent Federal Grades GS5, GS7 and GS9. Only the annual base entrance salaries are used in these calculations. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was July 31, 1959.

HOW TO HANDLE WET JOBS

#51 of a series

Project: Chrystie St. subway tunnel, New York City
General Contractor: Cayuga Foundation Corp., New York City
Pumping Contractor: Wellpoint Dewatering Corp., New York City

GRIFFIN WELLPOINTS LOWER GROUND WATER 42 FT IN ONE LIFT

Contractor finishes difficult subway job 18 months ahead of schedule as 700 wellpoint-eductor system keeps deep cut dry.

Problem: lower ground water 42 ft at hemmed-in subway work-site—open pumping hazardous—use of standard wellpoint system impractical.

Solution: a Griffin-engineered wellpoint-eductor system took the job in stride. With one-stage installation, one pump battery and no "tuning" of wellpoints, it kept the ground water under firm control as the contractor sped his work to early completion.

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In Venezuela: Drew Bear & Sons C.A., Caracas • Maracaibo

25th YEAR

CONCRETE PERFORMANCE REPORT:

POZZOLITH helps Norfolk and Western Railway Company speed tunnel concreting operation and assure maximum durability on 8270-foot tunnel project.

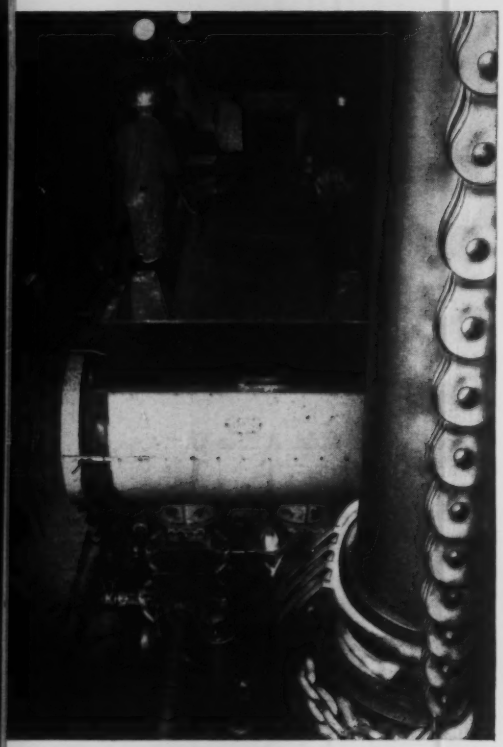
SANDY RIDGE

Sandy Ridge Tunnel—recently completed Norfolk and Western Railway Company project near Carbo, Virginia—is described as the longest railroad tunnel in Virginia or West Virginia.

Constructed to serve new coal mine properties developed by Clinchfield Coal Company, Division of The Pittston Company, the arch-type tunnel represents the major part of a $7 million investment. The project also included the building of 6.3 miles of main line railroad and about 9 miles of spur and operation tracks. A concrete highway bridge and a concrete underpass were built to effect grade separation between the railroad and a highway.

Sandy Ridge Tunnel was constructed from both ends, and, when the tunnel bore had been completed, the concrete floor and ballast walls were poured in order that track could be laid in the tunnel. Track through the tunnel was laid in prefabricated panels and was completed in 3½ days. Approximately 5 miles of track had already been laid north of the tunnel, using material hauled in by trucks. This enabled the Railway Company to give quick service to coal mines developed by the Clinchfield Coal Company. Two train movements a day were maintained through the tunnel during the concreting operation with practically no delays to trains or the contractor's progress.

The plan was a success—the result of extraordinary teamwork among the mine owners, Norfolk and Western Railway Company personnel, the contractor—and modern advances in concrete technology.



PLACING OF CONCRETE—The mix was pumped to the top of 27-foot high forms through 6-inch slick lines (foreground), then vibrated into place. POZZOLITH helped provide the exceptional workability required for this type of operation.

Boring and Mucking Out—Boring of the Sandy Ridge Tunnel began at the south portal on July 3, 1957, and at the north portal on September 27, 1957. The tunnel was holed through on May 17, 1958. During the 10½ months from the start of the initial boring operation until the tunnel was holed through, approximately 190,000 cubic yards of material—mainly seamy sandstone, unstable shale, and coal—were removed.

The unstable nature of material surrounding the bore required installation of steel H-beam supports placed on an average of 4-foot centers. Four-and-one-half million pounds of these structurals were used in the tunnel. In addition, 1-inch steel reinforcing rods were installed on 2-foot centers between the H-beams when the concrete was placed.

Designing the Concrete Mix—Primary requisite for the mix to be used in Sandy Ridge concreting operations was that it develop high early strength—740 psi in 10 hours. This was to permit stripping of each 60-foot steel form so it could be moved to the next position and refilled every 24 hours. A 3,000 psi compressive strength at 28 days was specified.

Exceptionally good workability was also required of the mix to assure successful placing with pumped concrete. And an extremely high degree of concrete durability was necessary to meet the 50 years service life anticipated for the tunnel.

Work on design of the concrete mix to achieve this early form-stripping schedule and meet the other engineering requirements, began six months prior to actual placing of concrete on-the-job.

Norfolk and Western engineers and the contractor, Ralph E. Mills Company, investigated the availability and quality of local materials. One-inch top size Pounding Mill stone and dolemitic sand were decided upon because of their favorable durability record. A Type I cement was selected, and samples of these materials were forwarded to the engineering laboratory of The Master Builders Company in Cleveland, Ohio, where studies were made of the rate of hardening characteristics of concrete with various cement factors and admixture formulations. The rate of hardening test employed was the Bond Pin Pull-Out Method described in ASTM Proceedings, Vol. 57, 1957.

The results of these studies were returned to Norfolk and Western engineers who analyzed the data and selected the following mix. For one cubic yard:

Cement:	517 lbs. (5½ sacks)
Sand:	1485 lbs.
Stone,(1"):	1800 lbs.
Water:	27 gals.
POZZOLITH:	1.375 lbs. (¼ lb. per sack cement)
Calcium Chloride:	11.0 lbs.

This mix performed most satisfactorily and gave sufficiently high strengths (with a margin of safety) to permit 10-hour form stripping at the 60° aver-

NORTH TUNNEL PORTAL—The great difference in elevation on the two sides of the rugged Sandy Ridge Mountain required a 150-foot cut in the north approach to avoid excessive track grade.

THE SANDY RIDGE TUNNEL project was planned and carried out under the general supervision of A. B. Stone, Norfolk and Western Railway Company Chief Engineer (since retired), Walter L. Young, present Chief Engineer, and B. E. Crumpler, Assistant Chief Engineer.

N & W Resident Engineers, C. W. Fiery and W. B. Cole, supervised the building of the tunnel under the direction of Pocahontas Division Engineer, L. A. Durham, Jr.

Contractor for the job was the Ralph E. Mills Company of Salem, Va. and Frankfort, Ky. General Superintendent and Project Manager—J. M. Lipscomb. William Houston was Tunnel Superintendent at the north portal and Richard Bingham at the south portal. Concrete tunnel lining operations were directed by Gus McMullin.

TUNNEL

age temperatures that prevailed in the tunnel.

Mixing and Placing Operations—Concrete materials were dry-batched in 1¼ cubic yard lots then transported to a 2-cubic yard dual power paving mixer at the south portal. The 4-inch slump concrete was finally discharged into rubber-tired dumpcrete bodies for delivery into the tunnel.

Concreting of the floor, curbs and footings proceeded immediately after the tunnel was holed-through. After curing was completed and tracks were laid, the tunnel opened for rail traffic on July 28, 1958—13 months after boring began.

Concreting of the tunnel lining began almost simultaneously at the midpoint of the tunnel and at the north portal. Two specially-fabricated, 60-foot long steel forms were used. Mounted on wheels, they were moved on 85-pound rails laid along the ballast wall.

The form was filled by pumping concrete at a rate of 50 cubic yards per hour. An average of 330 to 400 cubic yards was required for each 60 feet of tunnel lining. The concrete pump was part of a rail-mounted jumbo with two 6-inch diameter slick lines.

The POZZOLITH concrete mix had excellent coating of the aggregate and maintained its workability throughout the hauling and pumping operations. Only a few minor delays were encountered in pumping the concrete due to blocked lines.

The placing equipment was moved back and forth through the tunnel, alternately filling one form during the day shift and the other during the night shift. Twice daily, the jumbo was completely withdrawn and moved onto a siding to permit the coal-hauling operation previously described.

POZZOLITH and Master Builders Field Service—A total of 61,870 cubic yards of concrete were placed in Sandy Ridge Tunnel. POZZOLITH was used in approximately 50,000 cubic yards of the concrete and helped meet a broad range of engineering requirements. POZZOLITH was not used in the concrete floor and ballast curbs in the tunnel. Compressive strengths that permitted 10-hour stripping of forms were easily and economically achieved with a combination of POZZOLITH and calcium chloride. Other benefits resulting from POZZOLITH included reduced shrinkage and cracking, lower permeability and increased bond to steel.

From early planning through completion of the job, Master Builders field men and the Company engineering staff worked with the contractor to achieve uniform, superior quality concrete at lowest cost-in-place.

To better meet concreting requirements on your current and future projects—call in the local Master Builders field man. At no cost, he'll demonstrate—with your materials—how concrete produced with POZZOLITH becomes a more versatile and more useful building material . . . superior in performance, in quality and in economy to plain concrete or concrete produced with any other admixture.

FORM STRIPPING—In spite of forms being stripped every 10 hours, this work was carried out with no interruptions to coal shipments through the tunnel. Smooth, crack-free concrete surfaces required almost no finishing.

The Master Builders Company, Cleveland 3, Ohio • Division of American-Marietta Company
The Master Builders Co., Ltd., Toronto 15, Ontario • International Dept., New York 17, N. Y.
Branch Offices in all principal cities.

MASTER BUILDERS®
POZZOLITH*

*POZZOLITH *is a registered trademark of The Master Builders Co. for its concrete admixture to reduce water and control entrainment of air and rate of hardening.*

EJC Ad Series Continues to Promote Engineers

In its fall public service advertising campaign, Engineers Joint Council points to the importance usually given by the press to the architect and others connected with construction projects, but deplores the fact that little credit is given to the engineer who turns the architect's drawing into a useful building.

From time to time, EJC is running a series of advertisements on behalf of the engineering profession in *Editor and Publisher*, the business magazine of the newspaper profession. The series is intended to give engineering news writers and editors a wider understanding of engineers and the work they do.

One of a series

Just Who's Firing Those Missiles?

From the news stories you might think that Cape Canaveral is populated only by scientists and electronic brains. As a matter of fact, much of the design, construction and operation of our missiles and satellites is the work of engineers. Engineers don't want to take credit from the scientists, upon whose original research the missile program is based, but they do feel that the public should recognize engineering as a major force in the missile program.

Engineers Joint Council has been established by the engineering profession of the United States, to help you make the public properly aware of what the engineers are doing. For facts about engineers and the engineering profession, check with—

Engineers Joint Council
29 West 39th St., N. Y. 18, N. Y.
For information, call Pennsylvania 6-9220

EJC advertisement, which seeks to correct popular notion that engineers have nothing to do with the missile firing at Cape Canaveral, is shown here. Ad is one of three that have appeared recently.

EJC Studies Trends in Engineering Enrollment

To determine the reasons for the drop in freshman enrollment in engineering schools in the fall of 1958, the Engineering Manpower Commission of Engineers Joint Council and the American Society for Engineering Education made a study, early this year, of trends in freshman engineering enrollment. Since many of the factors in the study seemed to suggest the existence of a relationship between freshman enrollments in engineering colleges and first-year enrollments in less than baccalaureate programs, the Engineering Manpower Commission recently undertook a survey to evaluate trends in technical institutes offering curricula accredited by the Engineers Council for Professional Development.

It was found that 1958 first year enrollments in ECPD-accredited technical institutes increased over 1957 by 1.2 percent, but that this rise was substantially smaller than the increase experienced in 1957 (10.2 percent over 1956). Less than one-third of the institutes reported receiving a lower number of applications from qualified candidates. Although entrance requirements are being tightened in some institutes, it was suggested that enrollment is not measurably affected. Rather, it is thought, the number and quality of those completing the programs will increase. Significant increases in 1959 fall enrollments were anticipated by a majority of the technical institute deans and directors questioned.

Unlike engineering colleges, technical institutes did not experience a drop in enrollment at the first-year level. However, the rate of increase from 1956 to 1957 was sharply arrested and overall enrollment in 1958 remained essentially at 1957 levels. Apparently the factors that affected engineering enrollment in colleges also affected enrollments in the technical institutes. In 1957 freshman engineering enrollment increased by 1.3 percent over 1956 and in 1958 declined by 11.1 percent. Although the increase in first-year technical institute enrollment in 1958 was slightly more than 1 percent, this represented a drop from the previous year's increase of over 10 percent.

There appears to be no evidence that drop-off in engineering stimulated diversion of technical field candidates to the institutes, but rather that enrollment at both levels, in this period, was affected in the same way.

ECPD
Education Survey Shows Family a Major Influence

The family is the biggest single influence in guiding students into civil engineering. This rather surprising fact is revealed in a survey of 10,000 students recently conducted by the Engineers Council for Professional Development.

The survey, which included twenty-three engineering colleges in all parts of the country, found that 25.7 percent of the students responding had been influenced by their families to take up engineering as a career. Only 12.1 percent listed their teachers as an influence, and only 5.5 percent gave credit to school counselors for guiding them in their selection of engineering. Friends were a major factor in influencing 10 percent. Only 2 percent of the respondents listed the availability of scholarships as having an important bearing on their choice of a career.

Miscellaneous reasons, accounting for 44.7 percent of the replies, included such reasons as "own decision," "job and military experience," "contacts with engineers," "financial return," and "preference for mathematics and science."

In summarizing the survey, ECPD emphasizes the need to bring material on engineering opportunities to parents. This, it suggests, can be accomplished through talks by engineers to PTA and service groups and by more publicity and more emphasis on Engineers' Week activities. The summary also suggests greater attention to bringing the story of engineering to high school teachers and counselors. "As related to guidance work the survey means we must reach the young people directly," ECPD concludes.

5 PAVING RECORDS IN 14 MONTHS!*

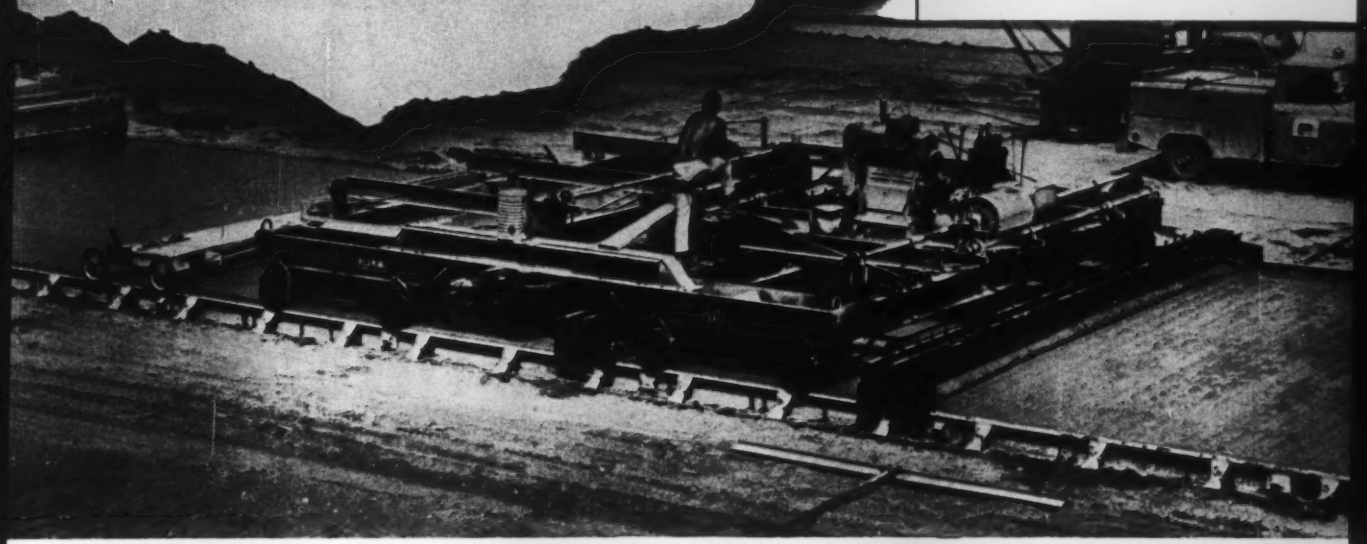
using Heltzel Flex-plane Combination Finisher-float Machines

** Paving records established using the Flex-Plane "Combination"*

1. **SARGENT CONSTRUCTION CO.,** Saginaw, Michigan, July,'58. 5787′ of 9″ x 24′ slab in 12½ hours.
2. **DENTON CONSTRUCTION CO.,** Grosse Pointe Woods, Michigan, Aug. '58. 6029′ of 9″ x 24′ slab in 12½ hours.
3. **KOSS CONSTRUCTION CO.,** Des Moines, Iowa, June '59. 6067′ of 9″ x 24′ slab in 12½ hours.
4. **PIERSON CONSTRUCTION CO.,** Saginaw, Michigan, August, '59. 6244′ of 9″ x 24′ slab in 12 hours.

Canadian Record:

5. **HURON CONSTRUCTION CO.,** Chatham, Ontario, July, '59. 5290′ of 9″ x 12′ slab in 12 hours.



Michigan contractor finishes 6244 feet of 9″ x 24′ pavement in 12 hours...paves 5 miles in 5 consecutive working days!

The most recent of 5 paving records has been achieved by Pierson Contracting Company of Saginaw, Michigan. From Saturday, August 8th through Thursday, August 13th, they paved 26,526 feet of 9″ x 24′ pavement on U. S. 12 near Hartford, Michigan. Total hours worked—52.

On Tuesday, August 11th, 6244 feet were paved in 12 hours for the longest single day's run—and another new U. S. paving record.

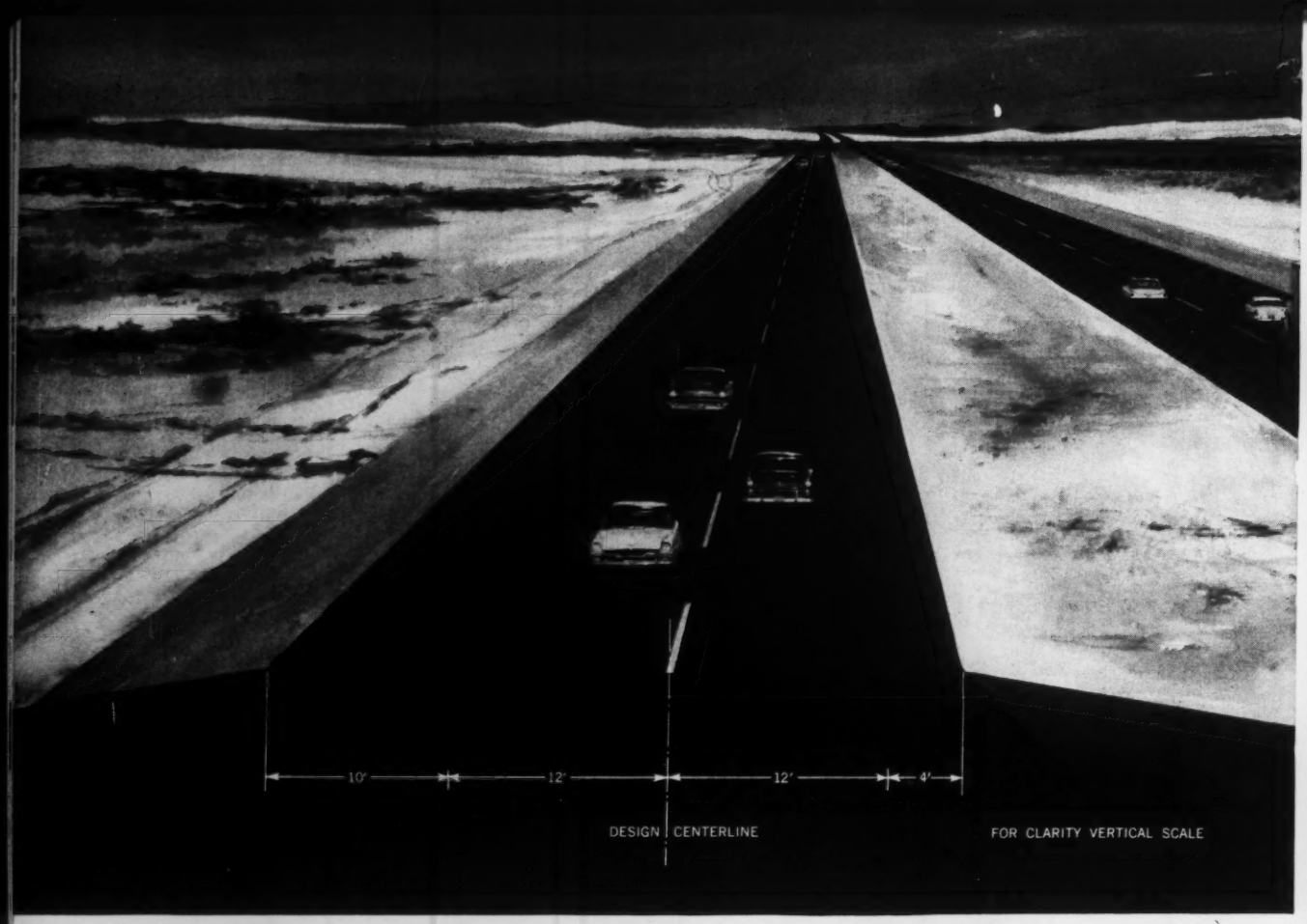
Speed is not the final measure of a finishing machine's worth. But the ability to produce a finish that meets or exceeds State and Federal specifications, plus the capacity to do it faster and more economically, is important to every paving contractor. Several of these record-setting contractors have stated that their record runs would not have been possible without their "Combinations". Further proof that top-rated contractors depend on Flex-Plane top-rated finishing equipment.

If you haven't seen the record-breaking 1959 Flex-Plane Gas-Electric Combination Finisher-Float Machine, call your Flex-Plane Distributor today or write direct to:

(above) Pierson's record-setting "Combination" at work on U. S. 12, Hartford, Michigan.

(below) Huron Construction's '59 Model Gas-Electric "Combination" setting new Canadian record.

THE FLEXIBLE ROAD JOINT MACHINE CO. Warren, Ohio



Arizona's First Interstate

Experience with veteran 2-lane Asphalt

Arizona is a big state with a low population density—which means it needs plenty of roads. But there aren't millions of Arizonans to pay for them. Every dollar counts.

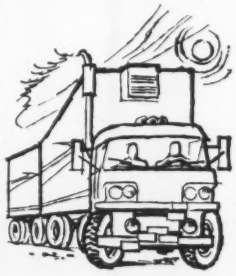
These are some of the reasons why most of Arizona's roads traditionally have been of economical Asphalt construction. Time and again, since the State began to pave, Asphalt pavements have stretched available funds over more and more of these long Arizona miles than could any other pavement type.

Now, along with the rest of the states, Arizona has launched a vast new road-building program. And even though more federal aid is available than ever before, these roads, too, are turning out to be Asphalt-paved. You don't have to look far for the reasons.

Arizona's veteran Asphalt-paved highways have proved themselves as rugged and durable as they were economical to build and maintain.

U.S. Route 66 between Winslow and Holbrook is an example. First paved more than 25 years ago (with Asphalt and sand!), this pavement is successfully supporting heavy traffic undreamed of when it was first built. "Double" trucks by the dozen barrel over it at 60 MPH. So does the bulk of Arizona's east-west traffic.

Now this veteran main artery, still in the prime of its life, is being given local traffic responsibilities. A new divided Interstate Highway (Route 40), carrying through traffic, will parallel it. The initial section of Arizona's new Interstate 40 is shown above. It is a 5.6 mile stretch between Winslow and Holbrook.



With no aggregate larger than ¾ inch available (and most under ¼ inch), only Asphalt construction could have been used to build this section of pavement up to Interstate standards. Total cost of the pavement structure was $1.75 per square yard!

½" WEARING COURSE
1½" ASPHALT PLANT MIX LEVELING COURSE
6" ASPHALT CURB
THE "WAFFLING" INTERLOCKS COURSES
1½" ASPHALT PLANT MIX BINDER COURSE
3" ASPHALT STABILIZED BASE (RC3)
VARIABLE 6" TO 15" SELECTED SUB-BASE
OF PAVEMENT IS EXAGGERATED
SUB-SOIL

Segment Asphalt-Paved!

pavements leads to decision

The cross section above shows you in detail how low-cost Asphalt materials were used to give this pavement lasting strength despite the scarcity of aggregate.

Notice, first, the use of Asphalt in the 3-inch base. This base, a sandy gravel, was road-mixed on the selected sub-base using RC-3 liquid asphalt.

Notice, second, (see right roadway above) that the 3-inch leveling course was asphalt plant-mix laid down in two courses. A novel between-course inter-lock was provided by "waffling" the lower course while still hot with a 4-inch square grid pattern, impressed about ⅜-inch into the surface. A tack coat was applied and a second course constructed. Then, a ½-inch wearing course was laid to insure a non-skid surface.

Notice, third, that both base and surface courses are uniform across the whole width of the road, shoulders as well as traffic lanes.

Notice, fourth, the use of Asphalt curb to provide controlled drainage, prevent embankment erosion and aid safety.

BEAT SCHEDULE BY TEN WEEKS

With today's equipment, modern heavy-duty Asphalt concrete pavement is being laid at record, reputation-building, tax-fund-conserving speeds. In this case, construction was completed 10 weeks ahead of schedule . . . in plenty of time to accommodate the bulk of the summer tourist traffic.

Modern Asphalt concrete pavement can help **you** speed your highway modernizing program. It provides, as well, strength, durability and economy in full measure. Specify it for your Interstate Highways. Primary and farm-to-market roads, too.

Ribbons of velvet smoothness . . .
***ASPHALT**-paved Interstate Highways*

THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closes May 1, 1960. See 1959 Official Register, page 143, and July 1959 issue of CIVIL ENGINEERING, page 66.*
FREEMAN FELLOWSHIP:	*1960-61 (closing date pending). See Official Register, page 154.*
ERNEST E. HOWARD AWARD:	*Closing date Feb. 1, 1960. See Official Register, page 142.*
ASCE RESEARCH FELLOWSHIP:	*1960 contest closes January 1, 1960. See Official Register, page 156.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 (closing date pending). See Official Register, page 156.*

License to Practice Is Required, Says Georgia Section

In a letter written in behalf of the Society, Executive Secretary W. H. Wisely has commended the Georgia Section for recent action protesting announcement of an opening for the position of city engineer of Decatur, Ga. The advertisement purportedly stated that "registration as a Professional Engineer (or a license to practice professional engineering)" was not required. Speaking for the Georgia Section's Professional and Registration Committee, Prof. Robert E. Stiemke has written to John H. Markland, city manager of Decatur. Professor Stiemke's letter reads as follows:

"An advertisement appearing in the Sunday, September 6, 1959, edition of the *Atlanta Journal-Constitution* has been called to the attention of the Professional and Registration Committee of the Georgia Section of the American Society of Civil Engineers. I did not see the advertisement, but it is reported to have announced an opening for the position of City Engineer for the City of Decatur and to have stated that registration as a Profesisonal Engineer (or a license to practice professional engineering) was not required.

"This letter is to call your attention to a state law which requires city engineers to be licensed to practice engineering in Georgia. The purpose of this law is to protect the public interest in life, health, and property. If the position to be filled in Decatur was actually that of City Engineer, and if the appointee was to assume responsibilities ordinarily assigned to that office, the reference to the lack of need for a license was ill advised.

"On the other hand, if the position to be filled was subprofessional and did not carry responsibilities of a professional engineering nature, the title should have been changed to so indicate.

"We know you will accept these comments in the same spirit in which they are submitted—to be helpful and constructive. This committee would appreciate your informing us of the action taken by the City of Decatur in filling the position in question."

Reinstatement to ASCE Membership Is Simple Procedure

Many members of the Society are dropped from the rolls every year. In the order of numbers, non-payment of dues, death, and resignation cause these separations. In spite of such annual losses, the total membership of the Society has doubled within the past twelve years. This fact furnishes an effective measure of the general opinion held by civil engineers as to the value of membership.

Many former members, particularly those dropped for non-payment of dues, are deterred from reestablishing their membership because of imagined difficulties connected with readmission. Comparatively few realize how simple the procedure for readmission is as established by the Board of Direction.

A former member, dropped for nonpayment of dues and desiring readmission, it *not* required to pay the sum of the yearly dues for all the years he has been off the rolls. The full procedure for reinstatement follows.

For Members Off the Rolls Less Than Three Years

Case 1, Dropped—A former member dropped for non-payment of dues is required to request reinstatement in writing to the Executive Secretary. Unless some special circumstance demands referral to the Board of Direction, the former member will be reinstated forthwith in his former grade of membership upon payment of (1) all or part of the current year's dues depending upon the month of reinstatement and (2) payment of dues for the earlier one-half year during which he received ASCE publications and services after being in arrears of dues, and payment for ordered items, if any, charged against his account when he was dropped from the rolls.

Case 2, Resigned—A former member who resigned in good standing is required to request reinstatement in writing to the Executive Secretary. Unless some special circumstance demands referral to the Board of Direction, the former member will be reinstated forthwith in his former grade of membership upon payment of all or part of the current year's dues, depending upon the month of reinstatement.

For Members Off the Rolls More Than Three Years

Case 3—A former member dropped for non-payment of dues or because of resignation in good standing and desiring reinstatement in his former grade is required to submit (on a special form furnished) a statement covering his professional record since the date his previous application was filed. He also must name three Fellows or Members who have knowledge of these interim engagements. His application must be referred to the Board. He may then be reinstated upon payment of dues as detailed in Case 1 for members dropped for non-payment of dues or, as in Case 2, covering members resigned.

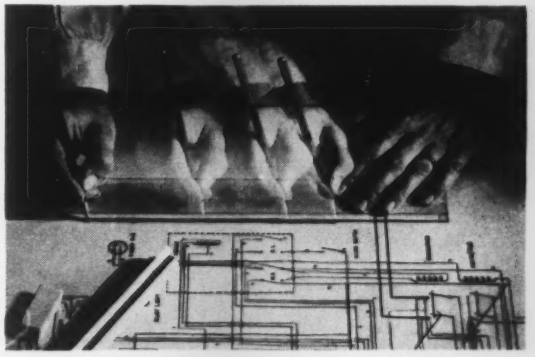
In some cases former members desire readmission to a higher grade than that held when they resigned or were otherwise dropped. Readmission to a higher grade is permissible. Dues clearance, as outlined in Cases 1, 2, or 3 whichever applies, must be obtained and possible difference in dues as between the old and new grade also must be provided for. In addition, the applicant must fill out the regular application transfer form showing his professional record since the date he filed his previous application.

In general, application for reinstatement in the former grade held is the preferable procedure. Once reinstated, an application for transfer to a higher grade is handled in routine manner.

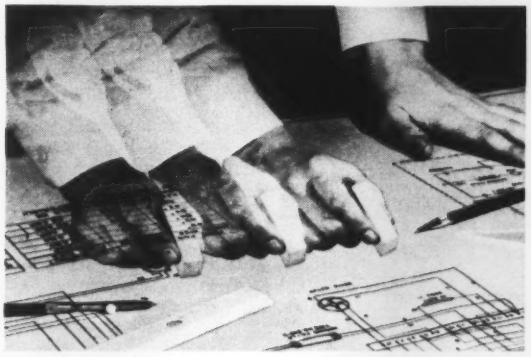
NEW! CRONAFLEX® DRAFTING FILM

The best surface on the toughest base . . . made and controlled by Du Pont from start to finish.

1 CRONAFLEX Drafting Film has excellent pencil acceptance. Its superb matte surface accepts printing and drafting inks.



2 CRONAFLEX Drafting Film erases easily, without ghosting, yet there is less smudging. It comes matted one or two sides, and is available in either rolls or sheets.



3 CRONAFLEX Drafting Film is .004" thick, which has been found to be ideal for drafting. Its rugged CRONAR* polyester film base will take repeated handling and countless trips through your reproduction machine and to and from your file drawer without cracking or becoming brittle. It lies flat, holds size, is flexible and impervious to moisture.

CRONAFLEX Drafting Film is the first product of its kind which is made in its entirety by a single manufacturer. The benefits can be summed up in two words: quality control. We control the manufacture of both base and surface, and we control the method by which they are made into the best drafting film you can buy.

This means that every sheet of CRONAFLEX Drafting Film has the same excellent pencil acceptance, the same erasability, the superb matte surface, the .004" thickness which has been found ideal for drafting and filing.

If drawings are made anywhere in your operation, you can use CRONAFLEX Drafting Film to great advantage. CRONAFLEX Drafting Film joins the widely acclaimed CRONAFLEX line of films: Direct Positive, Contact and Projection. You can go from original drawing to final reproduction with the same product line on the same strong base. For more information write: E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont of Canada Limited, Toronto.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

**Du Pont's trademark for its polyester photographic film base.*

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Installation of new **Brazil Section** officers took place recently at the Instituto de Engenharia in Sao Paulo. Mario Savelli is the new president; Julio O. T. Lohman, vice president; Henry Maksoud, secretary; and Nelson de Barros Camargo, treasurer. The ceremony also included presentation of Life Membership Certificates to James McKim Bell and Paul E. Gisiger.

Some members of the **Georgia Section** are working toward formation of a Structural Division within that Section. Interested engineers should contact Dennis Vickers, Eastern Engineering Company, P.O. Box 1286, Atlanta 1, Ga. . . . John M. Rungee has been appointed editor of the Georgia Section's "Civil Engineering." A member of the Georgia State Highway Department since 1948, Mr. Rungee is now road designer.

The public relations committee of the **Illinois Section** is preparing a nomination for the "Outstanding Civil Engineering Achievement of 1959" which is to be submitted through director Howard M. Peckworth. The Public Relations Committee, composed of Walter Linzing, chairman, R. C. Christensen, E. S. Hoffman and Frank Klein also is seeking a man to fit the "Chicago Civil Engineer of the Year" title among registered engineers in the Chicago metropolitan area.

The **Kansas Section** is instituting a Tornado Damage Study. The feasibility of the Section's participating in the formation of a District Council for District 16 will be the subject of study for another committee. At the September 21 meeting Prof. C. H. Scholer, of the Kansas State College of Agriculture and Applied Mechanics, spoke on the problems involved in the construction and maintenance of concrete built with coral aggregate in tropical areas. He emphasized that it is the corrosion and resulting expansion of metals in the concrete, activated by the presence of chlorides under high humidity and constant temperatures, and not the concrete itself, which causes cracking and impairs structural usefulness.

Members attending a recent meeting of the **Associate Member Forum** of the Metropolitan Section heard Martin S. Kapp, discuss the **$90,000,000 Brooklyn** Pier Development, Mr. Kapp, soils engineer for the Port of New York Authority, emphasized the foundation problems involved in constructing eleven new piers to replace the twenty three obsolete ones. Continuing its popular series of soil seminars. Robert White, of Spencer White and Prentis, Inc., told the group about combining temporary and permanent cofferdam construction.

"Reorganizing to Achieve Unity in the Engineering Profession" was the vital topic before a recent joint meeting of the **National Capital Section** and the District of Columbia Society of Professional Engineers. The 125 members, wives, and guests attending heard Paul H. Robbins, executive director of the National Society of Professional Engineers explain the functional plan for the engineering profession. ASCE Executive Secretary William H. Wisely gave the Society's position on the question of unity. It was the Section's first meeting of the season.

The **Richmond Branch** of the **Virginia Section** has elected its 1959-1960 officers. They are James W. Watlington, Jr., president; Raymond S. Gordon, vice president; and Claude E. Kinder, secretary-treasurer. Mr. Watlington is also treasurer of the Virginia Section.

TECHNICAL DIVISION MEETINGS

SANITARY ENGINEERING CONFERENCE

Cincinnati, Ohio
Netherland-Hilton Hotel
January 6-8, 1960

Sponsored by

Sanitary Engineering Division

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

Boulder, Colo.
University of Colorado
June 13-17, 1960

Sponsored by

Soil Mechanics and Foundation Division

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by

Hydraulics Division

ASCE CONVENTIONS

NEW ORLEANS CONVENTION

New Orleans, La.
Jung Hotel
March 7-11, 1960

RENO CONVENTION

Reno, Nev.
June 20-25, 1960

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

LOCAL SECTION MEETINGS

Cleveland—Regular monthly meetings scheduled for Friday, November 20 and December 18. Further information may be had by contacting the Section vice president, Trygve W. Hoff.

Illinois—Weekly luncheon meetings at the Engineers' Club, Chicago, every Friday, at 12 noon.

Intermountain—Regular monthly meeting on the fourth Friday of each month.

Los Angeles—Dinner meeting of the Soil Mechanics Group at the Engineers Club in the Biltmore Hotel (Suite 3333) on November 18, at 6:30 p.m.; reception and dinner meeting of the Transportation Group at the Engineers Club in the Biltmore Hotel on November 18, at 6:30 p.m.

Metropolitan—Regular monthly meetings scheduled for November 19 and December 16 in the Engineering Societies Building; cocktail and dinner meeting (roast beef at $3.00 per person) of the Associate Membership at the Swiss Cafe, 348 West 46th Street, on November 10, at 6:00 p.m. A. Gordon **Lorimer, AIA,** will speak on the aesthetics of bridge design.

Nashville—Annual meeting will be held in conjunction with the winter meeting of the Executive Committee of the Board of Direction at the Dinkler-Andrew Jackson Hotel on December 4, at 6:00 p.m.

ASCE Membership as of October 9, 1959

Fellows	10,842
Members	15,569
Associate Members	17,177
Affiliates	92
Honorary Members	47
Total	43,727
(October 9, 1958	41,839)

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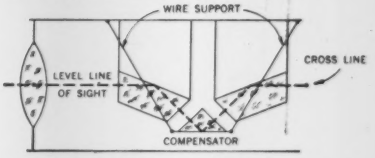
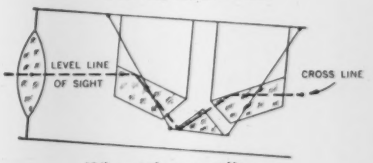
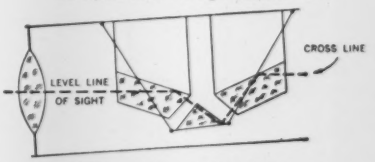


Telescope horizontal



When telescope tilts up, compensator swings backward



When telescope tilts down, compensator swings forward

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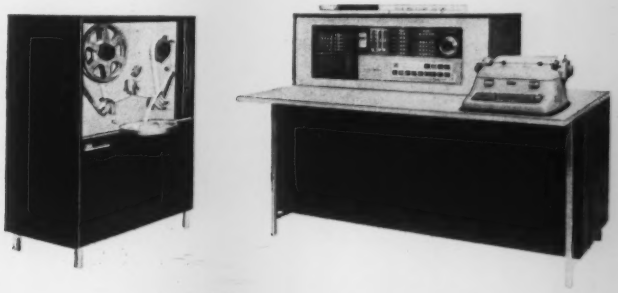

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This Mark Twain Expressway bridge has 3-span continuous girders 64'-76'-64'.

Steel is specified in 70% of bridge designs

This 4000' section of the new St. Louis freeway is a series of short-spans from 60' to 100' long. Cost of overpass: $6 million.

Major General Sverdrup (at right), President of Sverdrup & Parcel Engineering Co., discusses an Interstate Highway bridge with Mr. Brice Smith, Vice President of the firm. General Sverdrup was acting Chief Engineer to General MacArthur and later Commanding General of the Engineer Construction Command in the Southwest Pacific during World War II.

at Sverdrup & Parcel Engineering Company, St. Louis, Mo.

Detail of short-spans on 6-lane overpass, St. Louis, Mo.

Major General L. J. Sverdrup is president of Sverdrup & Parcel—world famous for highway and bridge designs. He says that the advantages of steel in bridge construction are proven by experience which accounts for 70% of their bridge designs being specified in steel.

One of the firm's most recent short-span projects is the $6 million, 6-lane, 4,000 foot overpass which cuts through the heart of downtown St. Louis. According to General Sverdrup, they used steel beams because they couldn't afford the extra time, special equipment and additional manpower needed to do the job with other materials. It was estimated that downtown traffic would have been tied-up for three to four months if they hadn't gone to steel. By using steel, all they had to do was swing it into place, bolt, rivet, weld . . . and they were in business.

Sverdrup & Parcel feel safe in specifying structural steel because its stress and endurance factors are a part of their library of proven facts.

In addition to the St. Louis highway project, some of the firm's outstanding achievements include: eight bridges across the Mississippi; six bridges across the Los Angeles River; two across the Ohio River; and structures on the Interstate Highway System, such as the Mark Twain Expressway bridges, as shown.

Increased facilities Because of the vigorous, ever-expanding demand for steel, the steel industry has greatly expanded its facilities for the manufacture of structural shapes and plates. You can confidently design in steel—the material you know best—the material that offers the most—knowing that steel will be available.

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BY-LINE WASHINGTON . . . . .

You can expect some solid results—in the form of suggested legislation—from the activities of Senator Kerr's Senate Select Committee on Water Resources. Committee staff members—almost entirely engineer-trained, by the way—have been holding hearings all around the country this fall, will wind up with more during the winter in Washington, may come up with recommendations before Congress is ready to go home for elections early in the summer. The suggestions may include one calling for a single federal agency to handle water resources.

* * *

A big boom in federal construction work in the Capital—and elimination of all 52 ugly "temporary" structures in the city—is now posible. It would result from a new law greatly expanding the power of the General Services Administration as the sole construction agency for the government (other than military), thus preventing other agencies from bypassing GSA and getting independent construction money from Congress. Armed with its new power, GSA is preparing the push quickly for an overall construction program that would: (1) Provide 12.8 million sq ft of new space in 22 new programs; (2) permit tearing down of the "tempos" and relinquishing leases on some 55 other structures; (3) permit abandoning 61 other "permanent" structures now occupied but long obsolete; and (4) permit consolidation of agencies under one roof.

* * *

Professional civil engineering status for topographic surveying, engineering surveying, land surveying, and geodetic surveying, is getting serious study by the Corps of Engineers, on urging from ASCE. Approval would, of course, mean an end to bidding now conducted by some division offices for these services and result in negotiated contracts.

* * *

A Federal Public Works Coordinator—proposed in a bill (HR 7682) due to come up next session—wouldn't need to be an engineer (or have any other special qualifications) under wording of the measure. His job would be to "promote long-range planning and coordination of efforts of all federal, state and local public works agencies"; compile statistics on work under way and in planning; consult with local agencies; and correlate federal and state study programs. The bill simply provides appointment with "advice and consent" of the Senate. Chances of passage are considered fairly good.

* * *

Are engineers paid on hourly rates "professionals"? The U. S. Supreme Court will answer that question this term. The lower courts have declared that such men are entitled to overtime pay, and thus are not on professional status. The case (docket No. 103) was brought to the high court by the Far West Engineering Co., Inc., a Los Angeles mechanical-electrical consulting firm, after lower courts had awarded ten former employees overtime pay amounting, in some cases, to more than $3,000 each. The employees were all graduate engineers, and employed—said the company—on "creative and design" acitvities, many with supervisory duties in addition. But the lower courts said the men were hired at a basic rate of $3.75 an hour, thus were hourly non-professional employees, regardless of what their employer chose to consider them.

* * *

Tremendous amounts of construction and planning money are involved in that pollution control bill (HR 3610) that failed by a matter of time to get through the past session of Congress but most certainly will go through in the session starting January 6. The present program (now operating for three years) calls for $50 million yearly federal grants-in-aid for local control works. The House approved raising the amount to $100 million annually, the Senate cut it to $80 million before running out of time. But you can multiply the amount of federal aid by nearly five, to get actual expenditures sparked by the program. Thus, to June 30 of this year, the U.S. had granted a total of $131 million, for 1,583 projects. But total actual costs of these projects was $685.2 million. There's a fly in the ointment: the administration has flatly opposed the whole program, wants the states to take over. A veto is fairly certain—but Congress could override, with elections coming up and money for local communities at stake.

* * *

Despite disclaimers, expect mostly politics from all that planned investigation of the highway program. As you've read, three separate investigations have been set up: by the House Ways and Means Committee; by the House Public Works Committee; and by the Office of the President. Ways and Means will do little or nothing; the President's group will be largely defensive. The chief investigation will be by Public Works, and note that the staff build-up so far has been chiefly in professional investigators, mostly ex-FBI people.

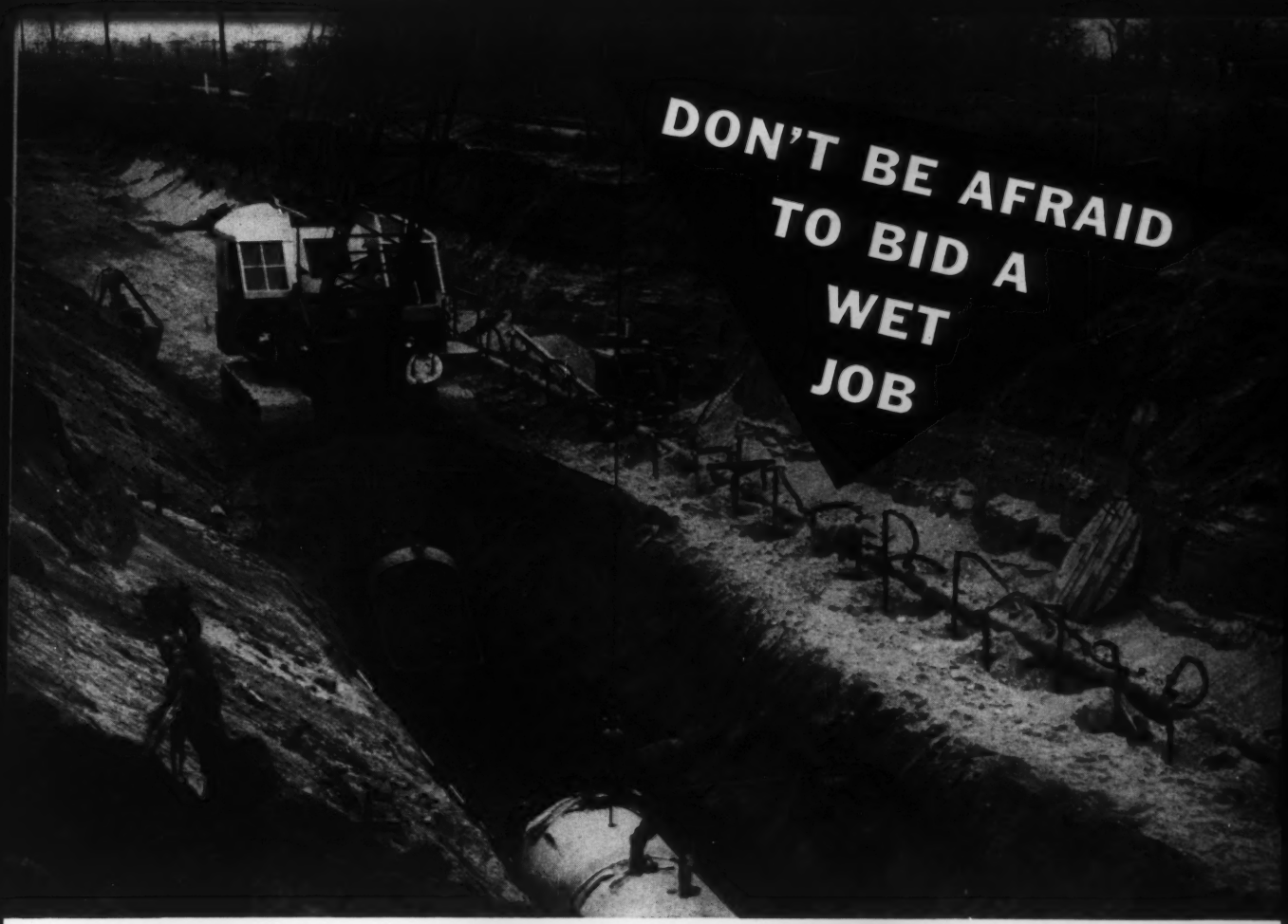
* * *

If you're working on federal-aid airport projects, send for a copy of the Federal Register of September 29. Starting on page 7810, the Federal Aviation Agency outlines in full regulations concerning applications for projects: sponsors, construction and contract procedures, eligibility, and other information. (Government Printing Office, Washington 25, D. C.)

* * *

The Supreme Court will have a final say on that long-standing argument over diversion of Lake Michigan waters at Chicago. Two actions by the State of Wisconsin (with New York joining in one of them) against Illinois and the Chicago Sanitary District, are up for action. Wisconsin demands that Chicago return all water it takes to Lake Michigan.

Other Supreme Court matters that'll be interesting to engineers include: Action of Arizona against California, seeking quiet title to Colorado River water that Arizona claims California has over-contracted for; action by Nebraska against Wyoming to clear rights to waters of the North Platte River; a series of three suits for and against the Tuscarora Indians over tribal rights to lands under the Niagara power project; a dispute between a householder and the City of Dayton, Ohio, where the owner claimed a city building inspector has no right to enter his premises, except with a search warrant; and a suit by a taxpayer of Fircrest, Wash., who charges that fluoridation of water supplies is an invasion of civil rights.



Contractors on three sections: Columbia Construction Co., Thompson Construction Co., Tousley Construction Co., Inc. — all Indianapolis

Photo shows one of the three sections of Lick Creek Sewer in Indianapolis, Indiana, where Moretrench Wellpoint equipment enabled the contractors to overcome threatening water levels and to place 50,000′ of pipe in a bone dry trench.

Water levels on the entire project varied from 15′ to 22′ in constantly changing soil ranging from all sand and gravel to stratified clay and gravel in a hard clay bottom.

Careful installation and expert supervision on this work guaranteed results — gave each contractor freedom to excavate as he saw fit and to progress as rapidly as possible with economy and safety.

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NEWS BRIEFS . . .

The Dalles Dam Dedicated

The sixth great Columbia River dam, The Dalles, was dedicated early in October in ceremonies headed by Vice-President Nixon and Lt. Gen. Emerson C. Itschner, F. ASCE, Chief of Engineers. Under construction for seven and a half years, the project took sixteen lives in the building and cost $250,000,000. Power from the first of the dam's projected fourteen generators went on the line in 1957. Now nine of them are in operation, feeding 729,000 kw into the grid of the Bonneville Power Administration. When all the generators are in service by the end of next year, The Dalles will have a power output of 1,119,000 kw —second only to Grand Coulee Dam (also on the Columbia), whose output of 1,944,000 kw is the greatest in the United States.

Navigation will be another important function of the new dam, which has a lock 675 ft long and 86 ft wide. The lift is 87½ ft. Since The Dalles is 193 miles from the ocean, a deep river channel will be needed to accommodate ocean-going vessels. However, smaller vessels are already carrying 1,500,000 tons of cargo a year past The Dalles. They bring alumina, the raw material for aluminum, from foreign ports to an aluminum reduction plant in operation near the dam site. There is also heavy river commerce in petroleum and wheat.

The Dalles, with a length of a mile and a half, is the longest dam on the Columbia, though it crosses the river at a point only half a mile wide. Since the river was not wide enough to accommodate both a powerhouse and spillway of the required size, a dog-leg, or right-angle, type of dam was decided upon. There are fishways at both ends of the dam.

The federal government has invested $2,000,000,000 in the Columbia River power system. To date 16 percent of the investment has been repaid.

Philadelphia Opens Push-button Water Treatment Plant

Philadelphia now has the world's largest automatically controlled water treatment plant. Its new $25,000,000 Torresdale Plant, which commenced operation on September 29, features a $500,000 control system engineered by a division of the Minneapolis-Honeywell Regulator Company.

From the time raw Delaware River water enters the 10-acre plant for preliminary chemical treatment until three and a half hours later when it is ready to be pumped into distribution mains from underground storage reservoirs, the purification process is constantly monitored and controlled by the instrumentation system. If any one operation in the cycle fails, the process is automatically halted. The system, which operates hundreds of valves and drains, permits complete washing of a filter unit in 30 minutes by a single operator in contrast to the three to six days required for a crew of 15 to 20 men to clean slow sand filters in the old plant.

The Torresdale Plant is a unit in Philadelphia's twelve-year $123,000,000 water improvement program scheduled for completion in 1964. With maximum capacity of 423 mgd, it is second only to Chicago's manually operated South District filtration plant, which has treated up to 488 mgd.

The new plant was designed by the Pittsburgh consulting firm of Morris Knowles, Inc. Samuel S. Baxter, new Director of ASCE, is Philadelphia water commissioner.

Nerve center of the elaborate system of controls for the Torresdale Plant shows part of the array of 48 instrumented desk-like consoles that cycle the cleaning of the rapid sand filters.

Sanitary Engineering Manpower Surveyed

The sanitary engineer's involvement in today's complex problems of environmental health—water and atmospheric pollution and radiological health hazards, to mention a few—is emphasized in a valuable new publication of the U.S. Department of Health, Education and Welfare. The publication, entitled *Sanitary Engineering Manpower*, analyzes the sanitary engineers' portion of the 1956 National Register of Scientific and Technical Personnel, which was developed by Public Health Service. Respondents were required to have a recognized engineering degree or to be licensed to practice. They must also be working in the sanitary engineering field. The authors are Frank A. Butrico, M. ASCE, and Israel Light, respectively chief and staff officer, Office of Engineering Resources.

The 4,000 sanitary engineers surveyed represent two-thirds of the estimated total number of such engineers in the country. The median age of the group is 44.5 years. About 56 percent of those surveyed have the bachelor's degree, and 40 percent have a graduate degree. Median income is $8,300. Salary data do not of course reflect a 10 percent increase in the past two years for federal (and probably other) employees.

Identified as Public Health Service Publication No. 703, the bulletin may be purchased from the U.S. Government Printing Office, Washington 25, D. C. It is 25 cents.

Port Authority Bus Terminal to Be Enlarged

A 50 percent increase in the size of the Port Authority Bus Terminal at 41st Street and Eighth Avenue is planned by the Port of New York Authority. The terminal improvement will cost an estimated $19,000,000. It is expected that the expanded terminal will be able to handle all bus passenger traffic entering and departing from mid-Manhattan in the foreseeable future, provided existing commuter rail facilities continue to be available. Improvements will include a new superstructure, to be erected above the present terminal, replacing the present roof parking area. The parking area will become an entry platform for buses.

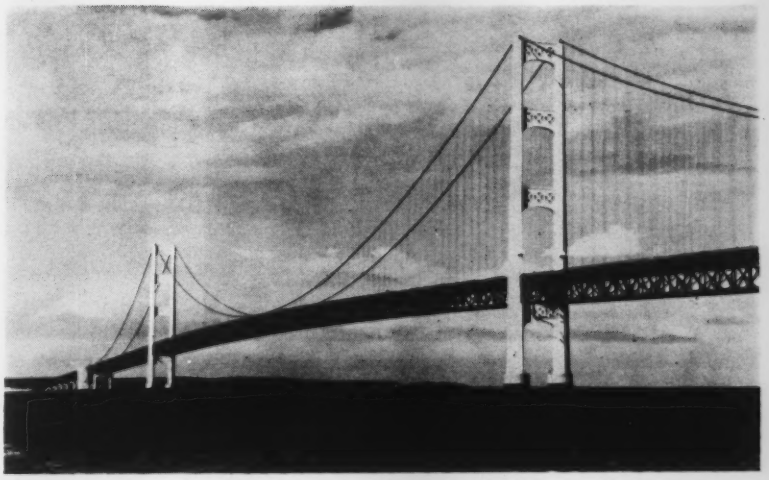
Construction will commence in March 1960 and be completed in September 1962. The terminal, largest of its type in the world, was opened in December 1950. On an average weekday in 1958 it accommodated 5,600 buses and 150,000 passengers.

Most Beautiful Steel Bridges Opened to Traffic in 1958

In its Annual Esthetic Bridge Competition the American Institute of Steel Construction has selected thirteen bridges in eleven states as the most beautiful steel bridges opened to traffic in 1958. This year there were 114 entries, the largest in the 31-year history of the competition.

Stainless steel plaques will be affixed to the outstanding bridges in each of three classes: **Class I** (for bridges with spans of 400 ft or more), the Mackinac Bridge; **Class II** (for bridges with fixed spans under 400 ft and costing more than $500,000), the Louie Morris Memorial Bridge over the Savannah River; and **Class III** (for bridges with spans under 400 ft, costing under $500,000), the Norwood Bridges over the Providence Turnpike in Massachusetts. There was no first award in Class IV, for bridges with movable spans.

The plaque-winning bridges are pictured at the right.



Mackinac Bridge over Mackinac Straits, Mich., is winner in Class I. The designer was D. B. Steinman, and the fabricator the American Bridge Division of the United States Steel Corporation. The jury praised the "monumental structure" for its "strength, handsome silhouette and beauty it gains from its noble proportions and mass."

Honorable Mention

Certificates of Honorable Mention were awarded to the following:

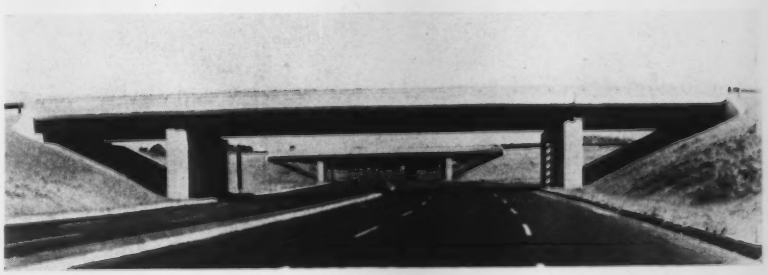
Class I: Greater New Orleans Bridge, designed by Modjeski & Masters.

Class II: South Fork Eel Bridge (Dyerville, Calif.), by the California Division of Highways; Clark Fork Bridge (Trout Creek, Mont.), by Ebasco Services, Inc.; Vine Street Bridge (Philadelphia), by Modjeski & Masters; Manahawkin Bay Bridge (Stafford Township, N. J.), by the New Jersey State Highway Department.

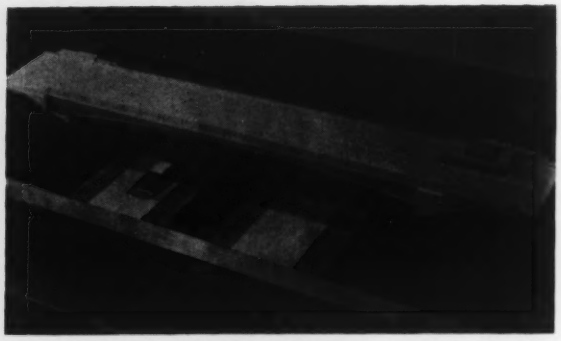
Class III: Bus Bar Tunnel Bridge (Muscle Shoals, Ala.), by the Tennessee Valley Authority; Lawrence Avenue Grade Separation (Chicago), by the Cook County Highway Department; Marsh Road Overcrossing (Redwood City, Calif.), by the California Division of Highways.

Class IV: Tenth Street Bridge over Black River (Port Huron, Mich.), by Hazelet & Erdal; Pelican Island Causeway (Galveston, Tex.), by Parsons, Brinckerhoff, Hall & Macdonald.

Louie Morris Memorial Bridge, near Anderson, S. C., is winner in Class II. The designer was Patchen & Zimmerman, and the fabricator the American Bridge Division. Its "lithe steel spans and simple muscular piers" appealed to the jury.



Norwood Bridges, Providence Turnpike, Mass., Class III winners, were designed by the Massachusetts Department of Public Works and fabricated by Tower Iron Works, Inc. The jury cited their "pleasing proportions that express a synthesis of the best in highway overpass design."



Top prize-winning entry in professional classification is shown at left. Winner, who received $15,000, was Allan M. Beesing, of Buffalo. First award in student classification, shown at right, is joint work of Niels Gimsing and Hans Nyvold, of Copenhagen, Denmark. Both are civil engineering students at the Technical University of Denmark.

Prizes Awarded in U.S. Steel Bridge Design Contest

Award winners in the $44,000 highway bridge design competition, sponsored by the American Bridge Division of U.S. Steel under the auspices of the American Institute of Steel Construction, were announced at the AISC headquarters in New York on October 6. Presentation of the awards will be made at a dinner meeting in Washington late in October.

The competition, which was devised to prove anew the versatility and economy of steel as a construction material, required entrants to design a steel bridge to carry a two-lane crossroad over a modern four-lane highway. It was open to professional design engineers and college engineering students anywhere in the world. There were 300 entries, fully one-third of them from foreign countries. Four of the fifteen awards went to foreign entries.

It was the consensus of the jury of award that "the professional entries were outstanding and represented a lot of thought and effort." As for the student entries, they commented, "the future of bridge design is in good hands." Speaking on the quality of the work turned in by students, one commented, "This is better than I could have done in my college days, which means better students today and speaks well of educational advances."

Top winner in the professional classification was Allan M. Beesing, structural design engineer with James J. McDonald, Buffalo, N. Y., who was awarded $15,000 for his entry. First award in the student classification went to Niels Gimsing and Hans Nyvold, of the Technical University of Denmark, who will share $4,000 for their entry. First honorable mention ($10,000) in the professional group went to a joint entry by Donald H. Olson, Two Harbors, Minn., and Jorgen Tvilstegaard, Minneapolis. Second honorable mention ($5,000) was awarded to a joint entry by Douglas M. Fraleigh, Marvin A. Shulman, and William J. Jurkovich, M. ASCE, all of Pasadena.

Five $1,000 third honorable mentions were made in the professional class. They went to a joint entry by Muhittin Ozyurt and Tsu-Ming Yan, Springfield, Ill.; Harry R. Powell, Seattle, Wash.; Robert J. Prowse, F. ASCE, Concord, N. H.; Klau Wehrli-Bircher, Zurich, Switzerland; and Michael and David Brunt, Aston Clinton, England.

First honorable mention in the student class (consisting of $2,000) was awarded to James C. Costello, Dublin, Ireland. Second honorable mention ($1,000) went to a joint entry by James A. Wood, Jack A. Berridge, and William O. Evers, all of California Polytechnic College, San Luis Obispo.

Jury of Award put in days of work in seclusion at Hidden Valley, Gaylord, Mich. Here four of the judges give one of the 300 entries careful scrutiny. They are (left to right) C. Earl Webb, consulting engineer, Okemus, Mich.; Craig P. Hazelet, consulting engineer, Louisville, Ky.; Walter E. Jessup, former editor of "Civil Engineering"; and Leon Chatelain, Jr., of Chatelain, Gouge & Nolan, Architects, Washington, D.C. Jury was under chairmanship of L. Abbett Post, executive vice-president of the AISC.

Improvement Program For LaGuardia Airport

Plans for expansion of the LaGuardia Airport reconstruction and improvement program from its originally estimated cost of $32,000,000 to $56,000,000 are announced by the Port of New York Authority. The original improvement program was announced in June 1957 by the Authority and scheduled airlines using the airport. Principal features of the revised program will be a $23,000,000 passenger terminal (five times the size of the existing structure), a two-level terminal roadway, a new runway, and enlarged parking facilities including a double-decked area adjacent to the terminal.

Pittsburgh Dedicates New Sewage Treatment Plant

On October 1 the Allegheny County Sanitary Authority dedicated its new $80,000,000 sewage treatment plant and disposal system, which will serve Pittsburgh and 69 surrounding municipalities. The badly needed plant, for which ground was broken in April 1956, will greatly reduce pollution at the head of the Ohio River. It is designed to serve an estimated population of 1,400,000 in 1970 and 1,650,000 by the year 2000.

Called the "nation's outstanding new pollution control project," the Pittsburgh sewage works includes a 150-mgd treatment plant, providing for 50 percent removal of the biochemical oxygen demand, and 69 miles of intercepting sewer (almost half of them in deep tunnel).

Under study for more than 40 years, the present project is an adaptation of recommendations made by the Allegheny County Sanitary Authority in 1948. It consists of more than 20 plants instead of the single treatment unit originally proposed.

John F. Laboon, F.ASCE, in his capacity as director and chief engineer of the Allegheny County Sanitary Authority, has been in charge of the project.

Aluminum Company Plans Large Research Center

A research and development center "without precedent in the world's metal industries" is the goal of a planning program just initiated by the Aluminum Company of America. A research pioneer in the metals field, Alcoa currently has an $18,000,000 annual budget for research and development activities. In addition, it has now appropriated over $30,000,000 for the start of work on its new center.

The present research facilities on a 60-acre site at New Kensington, Pa., will ultimately be replaced by a complex of facilities to be built on a 2,400-acre tract at Merwin, Pa., 28 miles east of Pittsburgh. Five or six major structures are planned for the first stage of the development. The layout will be of the campus type, with no building more than three stories high. Ground for the first installations will be broken within a year.

The New York City firm of Harrison & Abramovitz has been named architect for the new community of laboratories, development facilities, and administrative and recreational installations.

Bhakra Dam Structure Is Still Flooded

Engineers are still trying to stop the torrents of water coursing through unfinished Bhakra Dam, one of independent India's major construction projects. Late in the summer a hoist chamber gave way, flooding the galleries and a powerhouse and drowning ten workmen. Though engineers have now managed to divert most of the water away from the powerhouse, they have not yet been able to check the flood at its source.

Plans for stopping the escaping water involve finding and closing the diversion tunnel, which is causing the flood, and at the same time building a bypass tunnel around the caved-in hoist chamber. However, time and money will be required to put the plan in operation. Harvey Slocum, who has been superintending construction of the great project, is returning to the United States to enlist the aid of specialists and buy special equipment for the repair work. It is expected that repair costs will run into the millions.

Spanning a gorge in the Sutlej River, Bhakra Dam will be 740 ft high when it is finished, making it one of the highest dams in the world. It will irrigate over 10,000,000 acres, making it also one of the world's largest irrigation dams.

Best Median Barrier Found by Crash Tests

Cars traveling 60 mph crash into various types of median barriers in tests being conducted by the California Division of Highways. These impact studies were conducted in an attempt to develop a median barrier that would (1) prevent a vehicle traveling at high speed from getting into opposite lanes of traffic, and (2) reduce the severity of accidents in which vehicles strike such barriers.

Under conditions as consistent as possible, a total of 15 barrier designs were first tested. All the preliminary tests were conducted by driving a medium-weight four-passenger sedan into the various test barriers at approximately 60 mph and at an angle of collision of 30 deg. The crash car was driven by remote radio control from a pilot car following to the rear and left of it.

Additional final tests, using both an automobile and a 34-passenger bus, were conducted on the two designs judged to be the most efficient during the preliminary tests.

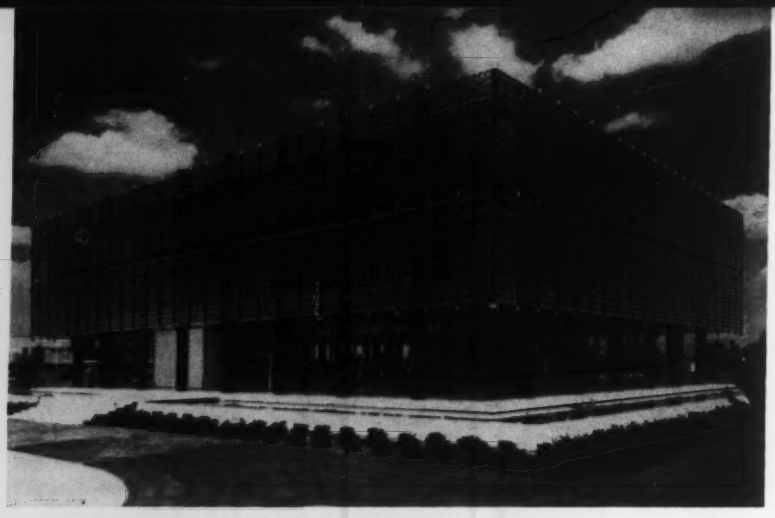
Acceleration recordings were taken from accelerometers strapped to a dummy in the driver's seat as well as from meters on the frame of the car. During the collision period, a series of high-speed and normal-speed cameras recorded all movements of the vehicle, the dummy (restrained by a seat belt), and the barrier.

Of the 15 median-barrier designs tested, only the combination cable-chain link barrier satisfied all criteria as an overall efficient barrier. This design, shown in the accompanying photo, appears to be well balanced in that it functions efficiently both in low-speed, low-angle collisions and in high-speed, high-angle collisions with passenger cars and in high-speed and high-angle collisions with buses.

A further advantage of this design is that it will also support a growth of ivy or other vines to serve as a screen.

It is estimated that the cable-chain link barrier costs about $5 per lin ft.

Our thanks for this information go to the July-August issue of *California Highways and Public Works*, where a more comprehensive report on these tests is presented in the article, "Impact Tests," by John L. Beaton, M. ASCE, and Robert N. Field, Jr., respectively Chief of the Structural Materials Section, and Materials and Research Engineering Associate, California Division of Highways.



Detroit Building Designed as Showcase for Aluminum

Extensive use of aluminum is featured in new aluminum office building opened in Detroit this fall by the Reynolds Metal Company as sales headquarters for its Great Lakes region. The three-story, $2,000,000 structure was designed to dramatize the utility and beauty of aluminium. About 200,000 lb of the metal was used in the structure, which features a gold-anodized aluminum sun screen covering the second and third floors on all sides. Screen consists of 10-in.-dia rings locked in a lacy pattern that does not obstruct office vision. Minoru Yamasaki was the designer.

EXAM GEMS

by

Reggie Strashn

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 4 asked applicants to "make a comparative cost study and recommend the most economical pipe" to convey 120 gpm 1,000 ft for 10 hr/dy and 300 dy/yr, from a 75 percent efficient pump using power at $0.01/kwh, if annual cost of plant was 13 percent of the given pipe cost. Installed cost of "ordinary cast iron pipe" ranged from $0.72 for 2-in. to $2.50 for 5-in. sizes.

It was hinted that some missing data must be supplied from experience and ingenuity, so let's look over the shoulder of Ike, the EIT, and watch him fill in the picture. In fact, he draws a diagram of pump and pipe, recording all the given data as dimensions and notes. He puts question marks on the static lift, the pipe roughness and the pump cost. Then he writes his "Assumptions":

1. Fluid is water (not given)
2. Pipe sizes are actual I.D. (Might be nominal, but sizes are not standard)
3. Pump cost same for any pipe
4. Static lift negligible
5. Roughness $n = 0.015$

These weren't all acceptable, but now he had a problem he could solve. He continued with, "Will compare the annual cost for each pipe as the sum of cost of plant plus cost of energy, or $C = C_p + C_e$. Let u = unit cost of pipe; then

$C_p = 13$ per cent $\times$ 1,000 $u = 130\ u$ (1)

Next he took the classical horsepower formula and his efficiency to write,

75 per cent $P = QH/8.8$

$P = QH/6.6$

King's Tables gave him 120 gpm = 0.26736 cfs for Q. He converted hp to kw with the factor 0.746, then to kwh by the 3,000 hr/yr, then to $ by the 0.01, finding

$C_e = 0.26736\text{H}/6.6 \times .746 \times 3{,}000 \times .01$

$= 0.9066\text{H}$ ..... (2)

All he needs now is H. Having assumed the static head negligible, he now states that H_v can be neglected for lengths exceeding 1,000 D, leaving only H_f, the friction head, given by this form of Manning's formula:

$\text{H} = 4.661\ L\ n^2\ Q^2\ D^{-5.33}$ ..... (3)

which reduced by setting $L = 1{,}000$, $n = .015$, $Q = .26736$, $d = 12\text{D}$, to

$\text{H} = 42{,}710\ d^{-5.33}$

$C_e = 38{,}720\ d^{-5.33}$ ..... (4)

from which he computed the following table,

d	$d^{5.33}$	u	C_p	C_e	C
2	40.3	0.72	93.6	960.3	1,054
2½	132.5	1.02	132.6	292.1	425
3	350.5	1.42	184.6	110.5	295
4	1,625	2.05	266.5	23.8	290
5	5,344	2.50	325	7.2	332

Having underscored the minimum C and corresponding d, Ike looked at his watch, sighed with relief, and turned the page. Too bad.

Ole right next to him hasn't turned his page. Let's peek at what he did. He overlooked the first two assumptions—took water for granted and sizes to mean diameters. He agreed on the third. Instead of the fourth, he stated that energy for any static lift would be the same for any pipe. Most important, for the fifth he cited authoritatively that $n = 0.013$ for new pipe but may worsen with time. His table looked like this,

d	C for n=			
	013	014	015	025
2	812	930	1,054	
2½	352	388	425	
3	268	281	295	491
4	284	287	290	333
5	330	331	332	345

Now he observed that the 3-in. pipe would be most econmical when new and as long as its average roughness was less than 0.0145. The 13 percent annual cost implied a useful life exceeding 10 yr, and much longer if a considerable part was maintenance. During such a life, average roughness would probably exceed 0.015, making a 4-in. pipe more economical, but would not reach 0.025, so that 5-in. pipe need not be considered. Inflationary trend would increase the cost of energy but not the initial cost of pipe. He concluded definitely, "I recommend 4-in. pipe as the most economical." Ole is now registered. Ike is an excellent computer.

EXAMGEM No. 5

Formulas should never be used except to expedite a routine computation you understand thoroughly. When formulas are offered but garbled by typists, those who can't ungarble them have no valid complaint. Look at this example given by Pennsylvania in 1953.

A certain Engineer's wife can buy a household deep freezer unit for $510 cash. She is offered an identical unit for 24 equal beginning-of-the-month payments of $25. What annual rate of interest is the vendor collecting for extending credit?

Equal-payment-series Present-worth factor is PR $\frac{(1+i)^n-1}{i(1+i)^n}$ and is designated by $\frac{\text{i-n}}{\text{(xxxx)}}$

"Essayons" Completes Suez Canal Dredging

The Corps of Engineers sea-going hopper dredge "Essayons" is back at work in New York Harbor after a record performance in dredging the Suez Canal. For the past seven months the dredge, largest of its type in the world, has been on lease to the Suez Canal Authority at a rental of $8,000 a day. The costs are being paid to the United States in dollars earned from the operation of the Canal. Working seven days a week, 24 hours a day, the "Essayons" removed 10,000,000 cu yd of material from Canal waters, deepening the channel from 37 to 43 ft.

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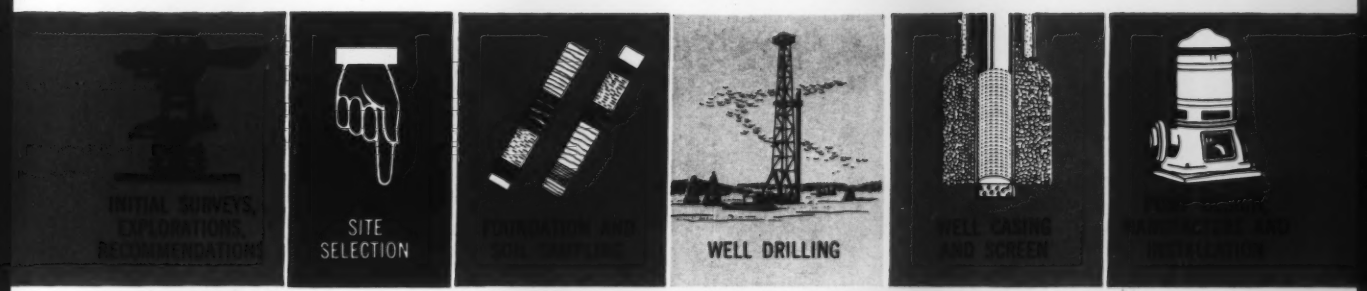

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LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

DECEASED

Alexander F. Armstrong (M. '10; F. '59), age 81, who retired in 1951 as president of the Albany Card and Paper Manufacturing Company, died in Albany, N. Y., recently. He graduated from Cornell University as a civil engineer in 1901. Early in his career he was in the Philippines as engineer in the Manila city engineer's office and superintendent of the Manila Department of Water Supply and Sewers. He had also been chief of the Bureau of Research of the New York State Highway Department at Albany.

Albert H. Bromley (Aff. '09), age 90, retired civil engineer of New York City, died recently in Haddonfield, N. J. A specialist in fireproof building construction, his background included eight years with the Vulcanite Paving Company, Philadelphia, Pa.; four years with the Guarantee Construction Company, New York, N. Y.; seven years with the Berger Manufacturing Company, Canton, Ohio; and nine years with the Fireproof Products Company, New York, N. Y. Mr. Bromley was a graduate of Drexel Institute in Philadelphia.

Elmer Allan Clees (A.M. '54; M. '59), age 40, a civil engineering employee of the State of Washington for twenty-three years, died in Seattle on September 15. At the time of his death, Mr. Clees was work control engineer for the department of highways and was active in community and engineering affairs. He was a bachelor of science engineering graduate of St. Martin's College, Olympia, Wash.

George W. Corrigan (M. '22; F. '59), age 82, former division engineer for the Southern Pacific Railroad at Los Angeles, died recently in Pasadena, Calif. Mr. Corrigan graduated from the University of Missouri at the turn of the century. He was with the Southern Pacific in various capacities from 1908 to his retirement in 1938.

Luzerne S. Cowles (A.M. '07; M. '59), age 83, retired civil engineer of Newton, Mass., died recently. Mr. Cowles graduated from Massachusetts Institute of Technology in 1897 and then did postgraduate work at the University of Geneva in Switzerland. He was with the Boston Elevated Railway Company on design of new structures from 1899 to 1917, and structural engineer for the Stone & Webster Engineering Company, Boston, from the latter year to 1932. He was an engineer in the Boston office of the Federal Emergency Administration of Public Works in charge of Massachusetts projects for several years before his retirement in 1939.

J. W. Cunningham, Former Society Officer, Dies

John W. Cunningham (M. '25; F. '59), age 72, who designed and supervised construction of many of the municipal water and sewer systems in the Pacific Northwest in a prominent engineering career, died in Portland, Ore., on September 17. Long active in ASCE, Mr. Cunningham was a past director (1941-1943) and vice-president (1948-1949). In 1941 he and J. O. Baar formed the firm of Baar & Cunningham, which lasted until 1935 when it was reorganized as John W. Cunningham & Associates. Mr. Cunningham was a member of the consulting board for design of the multi-million-dollar Portland sewage disposal project. He graduated with honors from the University of Wisconsin in 1908.

Walter A. Devine (M. '42; F. '59), age 70, Brookline (Mass.) town engineer and director of public works, died in Brookline recently. He first joined the city's engineering staff in 1906, becoming town

(*Continued on page 106*)

the bigger your pumping problems... the better your reasons for giving them to WHEELER-ECONOMY

The U.S. Corps of Engineers had a tough flood control problem at its Jeffersonville, Ind. station. They solved it neatly with 40 Vertical Mixed Flow Pumps like the ones you see here. The largest are 36″ Units which pump 23,000 gpm against a 32′ head.

Wheeler-Economy Pumps of this type with capacities to 220,000 gpm and over are used for flood control, drainage and irrigation in hundreds of locations. C.H. Wheeler has *specialized* in the design and manufacture of high-capacity pumps for nearly 75 years. It has the facilities you need to solve your toughest pumping problem. Ask any Wheeler-Economy representative about them. Or write direct for complete information.

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CITY.....STATE.....

MACOMBER

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(*Continued from page 104*)

engineer in 1940. Mr. Devine was educated at the Massachusetts Institute of Technology, Lowell Institute, Franklin Institute and Northeastern College.

Gilbert D. Fish (M. '27; F. '59), age 65, credited with having designed (in 1926) the first large welded building, died in Pelham, N. Y., on September 9. A graduate of the Columbia University School of Engineering, Mr. Fish taught mechanical engineering at his alma mater and Yale University. Since 1945 he had been a partner in the New York engineering firm Seelye, Stevenson, Value & Knecht. He designed the welded-joint and sub-assemblies for three new buildings for Mount Sinai Hospital, and recently completed work on a special secret project for the Navy.

Leo M. Geraghty (M. '31; F. '59), age 66, a project engineer for Lockwood Greene Engineers Inc., of New York City, died recently in Yonkers, N. Y. Mr. Geraghty attended Franklin Union in Boston, and the University of Massachusetts. He first joined Lockwood Greene, Inc., then of Boston in 1911, remaining there until 1928. Then he went to Columbia Mills, Inc., of Minetto, N. Y., as chief engineer, returning to the Lockwood Green Company in 1946.

Waldo Hartline (M. '36; F. '59), age 64, city engineer of Dover, Ohio, and consulting engineer of New Philadelphia, Ohio, died recently in New Philadelphia. He graduated from Ohio State University School of Engineering in 1918. Mr. Hartline was city engineer from 1922 on, and since 1926 had been parner in Arnold, Rosch & Hartline, New Philadelphia.

Hannibal S. Hatton (M. '46; F. '59), age 72, civil engineer for the Dyker Building Company, New York City, and a resident of Queens Village, died recently. In 1907 he graduated from the University of Maryland, and between 1909 and 1918 worked for the New York firms Post & McCord, Constructors, C. L. Gray Construction Company and A. L. Guidens & Company as general superintendent and civil engineer. He had a private practice in Washington, D. C., from 1918 to 1931, and more recently was with the Reconstruction Finance Corporation at Dallas, Tex., in responsible charge of government projects amounting to about $81,000,000.

Paul Kelly (M. '39; F. '59), age 65, for the past two years engineer of water extension for Yonkers, N. Y., died in Yonkers on October 3. Shortly after graduating from the School of Engineering of the Catholic University of America in Washington, D. C., Mr. Kelly became chief engineer of the Department of Public Works in the Dominican Republic on an extensive program of bridge and highway construction. As chief engineer of the New York District of the Army Corps of Engineers during World War II, he was responsible for the building of camps for outbound troops. This work was followed by a twelve-year partnership in the New York engineering and architectural firm of Kelly & Gruzen.

Solomon J. Kupperman (M. '43; F. '59), age 64, senior structural designer for the Chicago Division of Water Works, died in Pittsburgh, Pa., on October 1. Mr. Kupperman had been in the Design Division of the Chicago Water Bureau for over twenty-five years.

Daniel R. Lucchesi (A.M. '53; M. '59), age 38, structural engineer for the Portland Cement Association at Baltimore, Md., died there on September 24. A graduate of Loyola College, Mr. Lucchesi later received a B.S. degree in civil engineering from Johns Hopkins University and studied electronics at Yale. From 1943 to 1946 he was in active service in the U. S. Air Force, in which he attained the rank of captain.

George Miles March (M. '28), age 73, died recently in Lawrence, Kans. In the course of his career Mr. March had been city manager of El Reno, Okla., and of Independence, Kans., and from 1919 to 1928 was resident engineer for Black & Veatch of Kansas City, Mo. Mr. March attended the University of Kansas and received an A.B. in 1908, a B.S. in 1909, and a civil engineering degree in 1915.

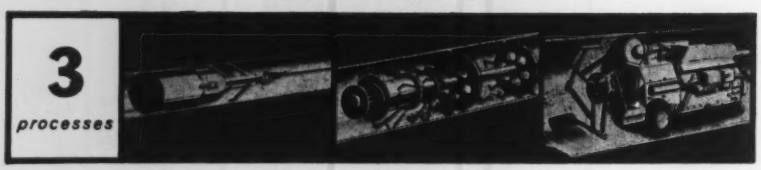
Claude Kelsey Mathews (M. '21; F. '59), age 62, since 1919 a member of the Burns & McDonnell Engineering Company, died recently in Kansas City, Mo. Following his graduation from the University of Kansas in 1919 with a B.S. in civil engineering, he was employed by Burns & McDonnell as a supervising engineer. He left in 1921 to do graduate work and teach at the University of Illinois, returning in 1924 as principal engineer. In 1947 he became a partner in the firm.

Howard P. McKown (M. '29; F. '59), age 74, resident engineer for the Allegheny County Department of Aviation, Greater Pittsburgh Airport, died at Indiana, Pa., on September 1. As an engineer with the U. S. Army Corps of Engineers, he had been employed on the construction of the Greater Pittsburgh Airport. For several years he served as Moon Township supervisor and engineer and as a West View councilman and engineer. Mr. McKown was a civil engineering graduate of Cornell University in 1909.

Conrad O'Connell (M. '55; F. '59), age 53, recently appointed chief engineer for the Plainfield (N. J.) Water Company, died in Westfield, N. J., on September 11. Before accepting the post of chief engineer earlier this year, Mr. O'Connell had served as general manager of Bailey

(*Continued on page 108*)

REHABILITATE
OLD, CORRODED OR LEAKY
PIPE LINES



THE TATE PROCESS is for pipe diameters from 4" to 16" and is done, "in place," after by-pass lines are set up to carry on with water service.

First, the pipe is scraped and cleaned. Then, cement mortar is fed in and applied under pressure to a compact thickness of 3/16" to 1/4" giving the final effect of one continuous, cement mortar lined tube.

THE SPUNLINE PROCESS is partly TATE and partly centrifugal, developed to provide a thin lining for preventing corrosion and to restore hydraulic flow, particularly in cast iron pipe. The cement mortar lining can go through bends and past openings. It can be applied "in place." Uninterrupted continuity is obtained.

CENTRILINE Centrifugal Process. Cement mortar lining ingredients are mixed to rigid requirements and applied under a high velocity spray with uniform speed. Rotating steel trowels spread the mortar to a smooth, hard finish. Pipe sizes vary from 16" on up to 144". Clay, cement, brick, steel, cast iron and wrought iron pipes may be CENTRILINED.

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Building an "ocean" terminal in Duluth

Sheetpile and earthfill construction are making a 120-acre marine terminal out of a 50-acre peninsula at the Port of Duluth, Minnesota. Duluth-Superior Harbor is the westernmost port of the St. Lawrence Seaway, with the largest volume of cargo of any Great Lakes port. The 10 million dollar marine terminal project will eventually supply berthing space for ten 500-ft ships, with transit sheds, warehouses, and two 90-ton cranes.

A marginal wharf on three sides of the new terminal was constructed by driving some 7,000 tons of Bethlehem Z-piling (section ZP38), in lengths of 58 feet. Dredging alongside this bulkhead provides a water depth of 32 ft, with 8 ft height above water, and 18 ft of penetration in the harbor floor. More than one million cu yd of fill were placed behind the bulkhead, most of it dredged from the harbor channel.

The bulkhead measures 1,600 ft along the north side, 1,700 ft on the south, and 2,700 ft on the east.

Builder of the terminal is the Duluth Port Authority. Contractor for bulkhead and fill is Zenith Dredge Co. of Duluth. Pfeifer & Shultz of Minneapolis are engineers for the project.

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BETHLEHEM, PA.
Export Distributors Bethlehem Steel Export Corporation

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VOIDED CONCRETE SLABS
FORM BRIDGE DECK

New Highway 67 Bridge, Flat River, Mo. Contractor: Clark Construction Co., Engineers: Missouri Highway Department; John Williams, Bridge Engineer, Jim Pasley, Ass't Bridge Engineer.

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reduce slab weight

The voided system of concrete construction permits the design of long span, lighter weight slabs without impairing structural strength.

In the highway bridge illustrated, end spans are 46 feet, and the center spans 56 feet; SONOVOID Fibre Tubes, 15.7" O.D., were used to form voids in the 24½" thick deck slab. By displacing low-working concrete at the neutral axis, SONOVOID Fibre Tubes reduce weight in concrete construction, and save concrete and reinforcing steel.

To speed construction, and for further economy, Seamless SONOTUBE Fibre Forms were also used on this job . . . those of 24" I.D. formed round concrete columns for the abutments and others of 30" I.D. formed the columns in each bent.

Sonoco SONOVOID Fibre Tubes are specifically designed for use in concrete floor and roof slabs, bridge decks, lift slabs, and precast, prestressed concrete piles.

Order SONOVOID Fibre Tubes in required lengths or standard 18' shipping lengths . . . sizes available from 2.25" to 36.9" O.D. (can be sawed). End closures available.

Steel strapping used as tie-down for SONOVOID Fibre Tubes on this job.

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SONOCO

Construction Products

SONOCO PRODUCTS COMPANY

4219

Deceased

(*Continued from page* 106)

Engineering Enterprises in Pasadena, Calif., and for nine years was district engineer for the Standard Oil Company of Venezuela. He attended Syracuse University and the University of California.

Former ASCE Director Frederick Paulson Dies

Frederick H. Paulson (M. '42; F. '59), age 61, former ASCE Director and partner in the firm of Charles A. Maguire & Associates of Providence, R. I., died on September 29. Mr. Paulson graduated from Brown University in 1920 with a degree in civil engineering and for the next fifteen years was a structural engineer for F. P. Sheldon & Sons, of Providence. In 1949 he joined Charles A. Maguire & Associates as chief structural engineer, and since 1953 had been a partner in the concern which has handled many of the largest engineering jobs in New England. Mr. Paulson was District 2 Director for the 1955-1957 term.

Charles Henry Pierce (M. '17; F. '59), age 81, former hydraulic engineer with the U.S. Geological Survey, died recently in Washington, D. C. A graduate of the University of Vermont with a master's degree from Harvard University, Mr. Pierce was assistant professor of civil engineering and mathematics at the University of Vermont in his early career. From 1910 to 1925 he was engineer and from 1931 to 1948 was hydraulic engineer for the Geological Survey. He was also author of numerous Survey publications. From 1925 to 1931 he was engineer for Charles T. Main, Inc., of Boston.

Clarence Osborne Sherrill (M. '20), age 82, Colonel, U. S. Army (retired), and former city manager of Cincinnati, Ohio, died there recently. Colonel Sherrill graduated from Trinity College (now Duke University) in 1897, West Point in 1901 and the Army Staff College in 1907. He served as Colonel of Engineers with the 302nd Battalion of Engineers in France from 1917 to 1920 and, in addition, was chief of staff of the 77th and 29th Divisions. Colonel Sherrill resigned from the Army in 1925 to become city manager of Cincinnati. From 1930 until his retirement in the mid-1940's, he was vice president of the Kroger Grocery chain.

G. Wallace Smith (M. '38; F. '59), age 65, professor and head of the department of engineering mechanics at North Carolina State College, died in Raleigh, N. C., on September 21. He was awarded a B.S. in electrical engineering from the University of North Carolina and an M.S. in

(*Continued on page 110*)

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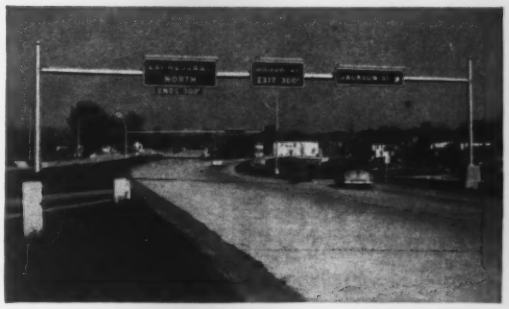
HIGHWAY PLANNERS

MONOTUBE LIGHTING POLES



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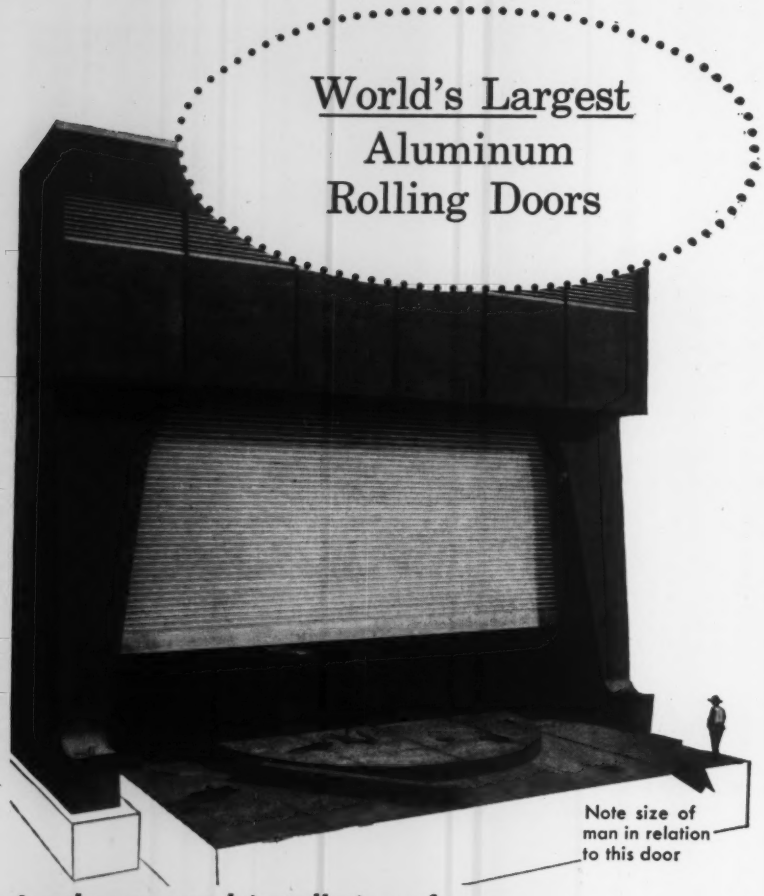

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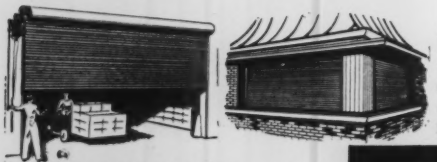
In 60 years of making metal rolling doors for industrial and commercial openings of every kind, we believe these are the largest ever made of aluminum.

Two doors 48 ft. wide and 39 ft. high enclose opposite ends of this 300-ton traveling gantry crane at the Robert H. Saunders — St. Lawrence generating station of the Hydro Electric Power Commission of Ontario. Similar Kinnear doors are used in New York's Robert H. Moses Power Plant, also part of the St. Lawrence project.

The doors are opened electrically as the crane is positioned over one of several open hatches in the generating station . . . then closed to permit working inside in any weather.

The space-saving efficiency and all-metal protection of Kinnear Rolling Doors cut costs in all kinds of openings — from counter-top areas to large industrial service doorways, as shown in the sketches below.

Every Kinnear Rolling Door is also REGISTERED — full details and drawings are kept in Kinnear's own fireproof vaults. *Your Kinnear doors are never obsolete, even if they serve for half a century or more — as many Kinnear doors have.*



Kinnear Rolling Doors are built any size, of steel, aluminum or other metals. Motor operation, with push-button control, if desired. Write for full details.

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KINNEAR
ROLLING DOORS
Saving Ways in Doorways

DECEASED

(*Continued from page 108*)

civil engineering and a doctor of science degree from the University of Michigan. Before going to North Carolina State in 1936 as associate professor of engineering mechanics, he had taught engineering at the University of North Carolina for fifteen years.

Arthur Vall Spinosa (M. '21; F. '59), age 79, of Parkersburg, W. Va., died there recently. A graduate of Kenyon College and Lehigh University, Mr. Spinosa had been vice president and general manager of the Penn Metal Company for more than twenty-five years. He joined Penn Metal in 1930 after serving as chief engineer and vice president of the Consolidated Expanded Metal Company for sixteen years.

Robert C. Wheeler (M. '23; F. '59), age 71, since 1920 a partner in the engineering firm of Barker & Wheeler, constructors of water supply distribution mains and sewage systems, Albany, N. Y., died recently in Brattleboro, Vt. His first employment after graduating from the University of Vermont was with the New York Central Railroad on the construction of the Grand Central Terminal. He then served as consultant to the New York firm of Hering & Fuller on water and sewage projects in a number of cities. Mr. Wheeler also designed distribution plants, reservoirs, and water mains for the cities of Athens and Piraeus in Greece.

Stacy H. Widdicombe (M. '24; F. '59), age 67, for the past thirty years senior engineer with Welding Engineers Inc., Norristown, Pa., and a resident of Phoenixville, Pa., died suddenly in New York City on July 18. Previously he had been chief engineer at the Shoemaker Bridge Company in Pottstown. Mr. Widdicombe was a graduate of the University of Pennsylvania and a veteran of World War I.

Joseph G. Wilburn (M. '43; F. '59), age 69, for many years a civil engineer with Robert & Company Associates, died recently in Atlanta, Ga. During World War II, Mr. Wilburn was office engineer for the Fraser-Brace Engineering Company on T.N.T. plants at Weldon Springs, Mo., and Meadville, Pa., and a Navy rocket plant at Camden, Ark.

Thomas Harrison Winchester (M. '32), age 74, owner and founder of the Winchester Engineering Company, Macon, Ga., died there recently. Prior to establishing Winchester Engineering in 1944, he worked on the construction of the hydroelectric projects for the Stone & Webster Company, the Rust Engineering Company, the Georgia Power Company and the National Park Service. Mr. Winchester was an alumnus of Virginia Military Institute and the University of Georgia.

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FOUNDATIONS FOR THE STRUCTURES OF AMERICA . . . COMPLETE CONSTRUCTION SERVICES ABROAD

New Publications

Highway research . . . . A wide range of current highway planning and research is reported in recent publications of the Highway Research Board. The list includes Bulletin 221, "Planning and Development in Urban Transportation—1959," $1.20; Bulletin 223, "Embedded Flexible Metal Pipe Culverts," 50 cents; Bulletin 222, "Highway Investment and Financing," $1.60; Bulletin 220, "Ice Melting Properties of Chloride Salt Mixtures," 50 cents; and Bulletin 219, "Skid Prevention Research," $1.40. Special Report 42, entitled "Highway System Classification" (a legal analysis), is $3.20; Special Report 45, on "Welded Highway Bridges," is $1.60; and Special Report 48, on "Federal-Aid Provisions in State and Highway Laws," is $2.40. Orders should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

Fire-resistant steel buildings . . . . Much of the significant information about fire-resistant materials and construction techniques available to the designer of modern steel structures has been summarized in a 44-page booklet released by the American Institute of Steel Construction. Inquiries about the booklet—entitled "Fire-Resistant Construction in Modern Steel-Framed Buildings"—should be addressed to the American Institute of Steel Construction, 101 Park Avenue, New York, N. Y.

Jet-age airports . . . . The problems that must be solved in locating jet airports and terminal facilities are discussed by Maj. John E. Peterson, of the U. S. Air Force, in an authoritative volume, entitled, "Airports for Jets." The 86-page publication contains extensive factual material including requirements and criteria for location and design. Copies, priced at $2.50 each, may be purchased from the American Society of Planning Officials, 1313 East 60th Street, Chicago 37, Ill. Quantity discounts of 20 to 30 percent are available on orders of ten or more copies.

Ohio water resources . . . . Issuance of an informative new monthly publication, "Ohio Water Resource," is announced by the Ohio Department of Natural Resources, Division of Water, Columbus, Ohio. The aim of the publication is to bring to persons interested in water conservation facts on Division of Water studies and activities; announcement of new Division publications; and related items from other sources.

Radioactive waste disposal . . . . A summary-analysis of hearings on industrial radioactive waste disposal—held in January and February 1959 by the Special Subcommittee on Radiation of the Joint Congressional Committee on Atomic Energy—has now been printed for the use of the Joint Committee. Inquiries should be sent to the U. S. Government Printing Office, Washington 25, D. C. The publication is entitled "Industrial Radioactive Waste Disposal."

Soil mechanics . . . . Special problems involved in designing railway structures in India, where "railway loads are not only heavy but have a considerable dynamic component" are dealt with by U.G.K. Rao in a paper-bound volume, entitled "Soil Mechanics for Railway Engineers." Copies may be purchased from the Office of the High Commissioner for India in London, India House, Aldwych, London, W. C. 2. They are 12 s. apiece.

Hydraulics . . . . Lehigh University announces that it has recently made a translation from the German of an important article entitled "Influence of Volutes on Characteristic Curves of Centrifugal Pumps," by F. Arisam-Zeitschrift des Vereines Deutscher Ingenieure. It is available as Translation No. T-5, Fritz Engineering Laboratory Hydraulics Division, Lehigh University, Bethlehem, Pa.

Nuclear fallout . . . . Data on fallout from nuclear detonations at the Nevada test site are summarized by Gordon M. Dunning, chief of Radiation Effects of Weapons Branch, Division of Biology and Medicine, Atomic Energy Commission, in an AEC manual entitled "Fallout from Nuclear Tests at the Nevada Test Site." The summary was presented at congressional hearings held in May. The report sells for 90 cents a copy and may be obtained from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Highway drainage . . . . Progress made in recent years in development of a gutter inlet grate for economical and efficient highway drainage is reported by John C. Guillou in Bulletin No. 450 of the University of Illinois Engineering Experiment Station. Copies are available from the Engineering Experiment Station, Urbana, Ill.

Plywood construction . . . . Plywood as a construction material is the subject of two interesting laboratory reports released by the Douglas Fir Plywood Association. Report No. 76—"Design and Testing of Rigid Frames with Nailed Plywood Gusset Plates," by William L. Petry, A.M. ASCE—presents a theoretical design method for rigid frames constructed of 2-in. dimension lumber (joined with plywood gussets) which are being successfully used in buildings with spans of up to 40 ft. Report No. 77—"Plywood Arch Panels," by Daniel H. Brown, A.M. ASCE, and Joseph L. Leitzinge, M. ASCE—discusses advantages and possible applications of arched plywood stressed-skin and sandwich panels, briefly describes the test method, and summarizes the test results and the design method which they confirm. Inquiries should be addressed to the Douglas Fir Plywood Association, 1119 A Street, Tacoma 2, Wash.

Engineering and scientific manpower . . . . Proceedings of the 1958 Conference of the International Science Foundation Brainpower Forum are now available. Inquiries should be addressed to the U. S. Naval Postgraduate School (Monterey, Calif.), which was host to the 1958 conference. The Brainpower Forum was established in 1956 by five member groups of the ISF to study ways of utilizing all available sources of scientific manpower. The 1958 conference was devoted to study of better utilization of retired or senior professional manpower. Participants in the Brainpower Forum are the Army Ballistic Missile Agency, the Cooperative Research Institute, the U. S. Navy Radiological Defense Laboratory, the California Academy of Sciences, and the National Association of Manufacturers.

Prestressed concrete . . . . Tests of 43 rectangular and 56 I-beams are described and analyzed in "Strength in Shear of Beams Without Web Reinforcement," issued by the University of Illinois Engineering Experiment Station as Bulletin No. 452. The report is released as Part I in the university's investigation of prestressed concrete for highway bridges. Copies, priced at $1.00 each, are available from the Engineering Experiment Station, Urbana, Ill.

Engineering manpower . . . . The important problem of utilizing scientists and engineers to fullest advantage was probed for the benefit of industrialists in the Delaware Valley area at a conference held in Philadelphia in May 1958. Sponsoring groups were the industries, educational institutions, and professional societies of the Delaware Valley. The conference Proceedings, edited and published by Drexel Institute of Technology, are now available from the Public Relations Office, Drexel Institute, 32nd and Chestnut Streets, Philadelphia 4, Pa. The cost is $4.00.

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65 CORES A DAY WITH HIGH SPEED ACKER DIAMOND BIT

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Applications for Admission to ASCE, Aug. 29-Oct. 3, 1959

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(New Grade)

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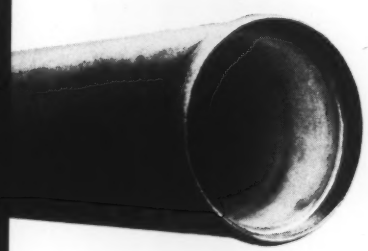
JOHN HENRY BOYD, Wenatchee, Wash.
CHARLES THEODORE BRADLEY, Sharon, Mass.
JOHN DOUGLAS STUART BROOKES, Bienfait, Saskatchewan, Canada
MATTHEW LAMBIE CLARK, Kuala Lumpur, Malaya
NORMAN BOWER CLEVELAND, Boston, Mass.
JOHN STEWART COUGHLIN, JR., Los Angeles, Calif.
EDWARD CLARENCE CRAWSTON, Los Angeles, Calif.
CHARLES J. DIETZ, Harrisburgh, Pa.
ERNEST LLOYD DODSON, Overland Park, Kans.
LOWELL LEVON ELDER, Columbus, Ohio
WILLARD ELLIS, Denver, Colo.
EBRAHIM KHALIL ENTEKHABI, Tehran, Iran
ALBERT DANIEL FIELD, Sparrows Point, Md.
RICHARD FREDERICK GODMAN, Kent, England
CHARLES FREDERICK GURNHAM, East Lansing, Mich.
LUDWIG ADOLPH HAAS, Milwaukee, Wis.
LLOYD EDWARD HAMMAN, San Francisco, Calif.

(Continued on page 114)

EXTRA SAFETY FACTOR!



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*PM permanently and positively waterproofs sub-grade vertical walls . . . average cost is only 10 cents per square foot installed

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*Premoulded Membrane TRADEMARK the industry's only TRUE vapor seal

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Applications

(Continued from page 112)

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MURLIN RAY HODGELL, Manhattan, Kans.
ROBERT GEORGE HOEHN, Fort Wayne, Ind.
JOHN ROTH HYLAND, Columbus, Ohio
ROBERT BRUCE JACKSON, Ephrata, Wash.
NELSON C. JONES, East Lansing, Mich.
JOHN PAUL KEEN, Binghamton, N. Y.
BARTLETT LEONARD KENNEDY, Santa Monica, Calif.
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LADISLAV BOHUMIR KRIZ, Skokie, Ill.
WALLACE NEWTON LIMBRICK, Long Beach, Calif.
JOHN DOUGLASS LOCKE, Carmichael, Calif.
CLIFFORD VINCENT LUCAS, Sacramento, Calif.
HARRY RICHARD LUNDGREN, Scottsdale, Ariz.
HINKLE McLENDON, JR., Charleston, S. C.
ISIAH MEYER, Sacramento, Calif.
GENE RAY MORRIS, Phoenix, Ariz.
PAUL ALFRED MOWBRAY, Santa Rosa, Calif.
ROBERT LINTON MUSHEN, Fort Ord, Calif.
ROYALL EDWARD NORTON, Seattle, Wash.
GEORGE MARTIN PARKER, JR., Dallas, Tex.
HARRY ROBERTS POWELL, Seattle, Wash.
WALTER RAYMOND PRITCHETT, Dallas, Tex.
PARATHASARATHY N. RAJAN, Madras, South India
KAREL REJCHA, New York, N. Y.
PAUL HERBERT RICHARDSON, Jamaica, West Indies
ROBERT CLOUGH RIESS, Dearborn, Mich.
HENRY CALDWELL ROBINSON, Holden, Mass.
DAVID ROSENBLATT, Balboa, Canal Zone
STEN ROSENSTROM, Sundsvall, Sweden
JAMES ANTHONY SAMARTANO, Chicago, Ill.
PETER J. SHORT, JR., Coatesville, Pa.
LEROY JOHN SNYDER, Baghdad, Iraq
ROBERT EUGENE SQUIRES, Ft. Wayne, Ind.
HENRY STERNGOLD, North Miami Beach, Fla.
WINSTON GRAFTON STEVENSON, Montgomery, Ala.
ROBERT WINGATE TRAXLER, Salt Lake City, Utah
SAVATORE JOSEPH TROMBETTA, Atlanta, Ga.
JOHN PETER VEERLING, New York, N. Y.
VALERIAN VILLANYI-HAUSNER, New Orleans, La.
JACK EDWARD WAGNER, Los Angeles, Calif.
THOMAS ANTHONY WIDDRINGTON, New York, N. Y.
JEWELL THURMAN WOOD, Tulsa, Okla.
ROBERT ROSS YOUNG, Cleveland, Ohio
JACK ZWECKER, Atlanta, Ga.

Applying for Associate Member

(Old Grade)

NELSON VEN-CHUNG NEE, Knoxville, Tenn.

Applying for Associate Member

(New Grade)

AHYDAR HANNA ABU-JABIR, Beirut, Lebanon
JAMES JOSEPH ANDERSON, West St. Paul, Minn.
HAROLD FREDERICK BARNES, Ames, Iowa
RICHARD EMMETT BARNES, New York, N. Y.
KEITH GAVIN BARRETT, New York, N. Y.
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REYNOLD JOSEPH BLUNK, JR., Azusa, Calif.
ASGHAR HUSSAIN BOKHARI, Rawalpindi, West Pakistan
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CHELAPATI VENKATA CHUNDURI, Urbana, Ill.
ALEC PANOS COURTELIS, Miami, Fla.
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WALTER SAMUEL FERGUSON, Yuba City, Calif.
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RALPH EDWARD HAUKE, Palisade, Colo.
AARON WARD HENDRY, Tampa, Fla.
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N. VEERASUBRAMANIAN, Manipal, South India
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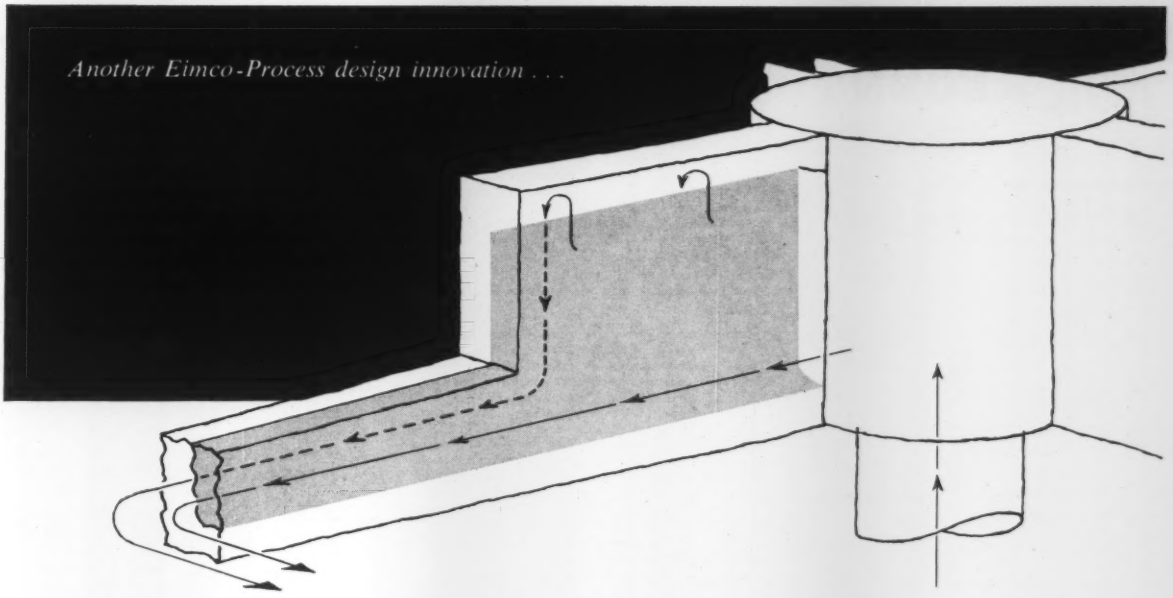
EDWARD ROSS WISE, Baltimore, Md.
RICARDO YAMASHIRO, Urbana, Ill.
BASIL ZARBOULAS, Ames, Iowa

[Applications for the grade of Associate Member from ASCE Student Chapter Members are not listed.]



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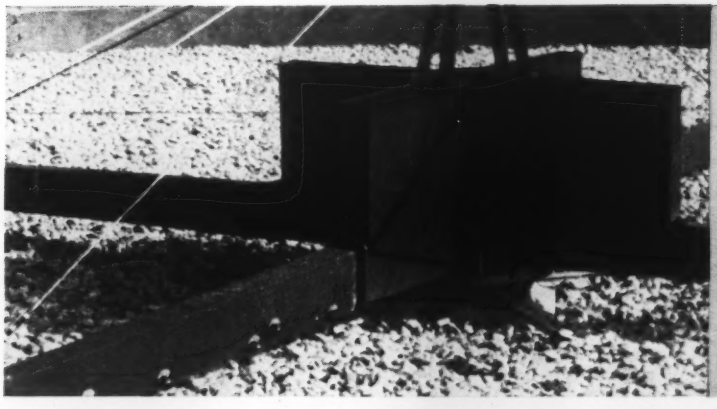

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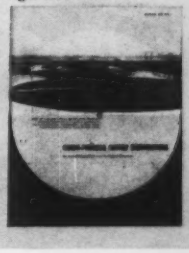

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The Economics of Nuclear Power, Including Administration and Law

Volume 2

A continuation of other volumes in this series (Progress in Nuclear Energy, Series VII), the present volume discusses the world demand for nuclear energy; nuclear fuel supply and costs, with particular reference to uranium mining costs; the generation of nuclear energy, including its application to purposes other than electricity generation, the cost of generating electricity for nuclear reactors, and the effect of reactor design on costs. Nuclear power programs in various countries are also discussed. (Edited by I. R. Maxwell and others. Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y., 1959. 419 pp., bound. $17.00.)

Foundation Design and Practice

AN ECONOMIC VIEW

by J. H. Thornley. The first book on foundations to emphasize economy in designing and building. Its purpose is to help the designing engineer choose the correct foundation for a given structure at the least possible cost to the owner. A six-page Elimination Table enables the designing engineer to narrow his choice to those designs best suited to the particular job. xi+298 pages, 49 detailed line drawings. $15.00

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Featuring an approach combining theory and practical application, methods for both design and detailing are presented. Among the topics covered by the author are flexural stresses in timber, plain-concrete, and reinforced-concrete beams; bond, shear, and diagonal tension; anchorage, embedment, and anchor bolts; reinforced concrete columns; retaining walls; foundation design for a steel-framed building; and detailing and drafting of reinforced concrete structures. (By Sylvan P. Stern. Prentice-Hall, Inc., Englewood Cliffs., N. J., 1959. 444 pp., bound. $10.60.)

New Instruments and Methods of Engineering Geology

In this translation from the Russian a concise review is given of new methods and apparatus which can be applied in improving the quality and productivity of exploratory work in engineering geology and hydro-geology. Emphasis is placed on methods using the radioactive properties of elements, particularly those that are simplest in operation and hold the most promise in terms of effectiveness. However, other methods based on various physical methods are also considered. (By N. V. Glazov and A. N. Glazov. Consultants Bureau, Inc., 227 West 17th Street, New York 11, N. Y., 1959. 91 pp., bound. $3.25.)

An Introduction to Plasticity

Particular emphasis is placed on the effects of plastic deformations on the mechanical behavior of structures. In most cases highly simplified stress-strain relations are used that describe idealized rigid-plastic or elastic-plastic behavior. Due to these simplifications, satisfactory results are obtained not only for beams and trusses, but also for frames, plates, and shells. The discussion on finite deformations indicates that the results may be applied to forming processes such as rolling, extruding, and drawing. (By William Prager. Addison-Wesley Publishing Company, Inc., Reading, Mass., 1959. 148 pp., bound. $9.50.)

Steam Power Plants

All classes of steam boilers and steam electric plants form pressures above low pressure heating installations up to super-critical high-temperature installations are covered. The mode of operation of the various power plant apparatus and how they are tied together into a complete operating power plant is described. Instruments, safety devices, and electric equipment are also discussed, as are the factors that must be considered in achieving economical power production. (By Charles Donald Swift. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1959. 491 pp., bound. $11.50.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by (the Society's initials, eg. ASCE) members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Theorie Der Verbundkonstruktionen

Two Volumes

This manual on composite construction deals with structures consisting of any type of combination of concrete and steel, including prestressed. *Volume I* presents the theory and basic calculations; *Volume II* contains 28 numerical examples in three groups: symmetrically reinforced statically determinate frameworks; unsymmetrically reinforced frameworks; statically indeterminate structures. (By Konrad Sattler. Wilhelm Ernst & Sohn, Berlin, German, 1959. Bound. 90 DM.)

Non-ASCE Meetings

American Institute of Chemical Engineers. Annual meeting at the Sheraton-Palace Hotel, San Francisco, Calif., December 6-9. For advance registration and other information write to the American Institute of Chemical Engineers, 25 West 45th Street, New York 36, N. Y.

American Institute of Consulting Engineers, Inc. Winter meeting at the Statler Hilton Hotel, New York, N. Y., January 31-February 5. Contact the American Institute of Consulting Engineers, Inc., 33 West 39th Street, New York 18, N. Y.

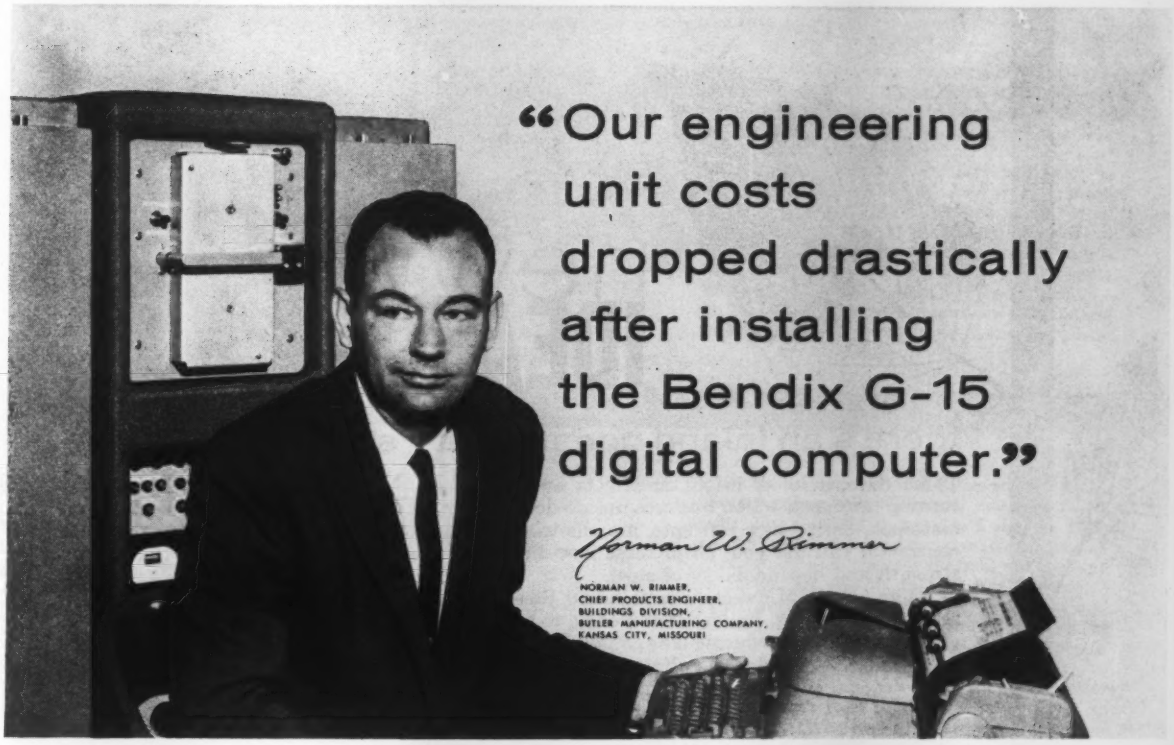
American Society of Mechanical Engineers. Annual meeting at the Chalfont-Haddon Hotel, Atlantic City, N. J., November 29-December 4. For details write the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

National Swimming Pool Institute. Convention and exposition at the Coliseum and Statler-Hilton Hotel, New York, N. Y., December 12-15. Address queries to the National Swimming Pool Institute, Harvard State Bank Building, Harvard, Ill.

Positions Announced

City of Miami. The Department of Water and Sewers announces that the Civil Service office is accepting applications for an examination on December 29 and 30, 1959 for a Civil Engineer II (structural) register. In order to qualify, applicants should be between the ages of 27 and 50, possess a B.S. in engineering plus five years progressive civil engineering experience, four of which must have been in the design of reinforced, prestressed concrete and steel structures or nine years progressive experience in the work described above. The in-hiring rate of pay is $534 per month plus $25 per month cost of living bonus. Send summary of qualifications, experience and transcript of college credits to Robert A. Richmond, Examining Supervisor, City of Miami Civil Service Office, 3318 Pan American Drive, Miami 33, Fla.

The Douglas Fir Plywood Association. Plans are for nineteen new men to be added to its field promotion force in 1960. The non-profit trade association is seeking graduates or near graduates in architecture, civil engineering, industrial design, agricultural engineering or forest products. Also to be considered are men with the equivalent professional experience who seek greater advancement than their present position offers. The job entails four days per week in the field and one day in office work. Salary to start is commensurate with qualifications and current earning ability. Interested parties should contact the Douglas Fir Plywood Association, 1119 A Street, Tacoma 2, Wash.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Butler's progressive engineering program requires a fast, versatile, and low-cost computer. It must handle complex structural problems and still be simple enough to be used by engineers with no programming experience. The computer's mission: cut engineering unit costs. *"Our own survey proved that the Bendix G-15 digital computer could best do this job,"* says Mr. Rimmer, *"and it does."*

For Butler, part of the cost-cutting versatility of the G-15 stems from the variety of programming methods they can use. For the solution of repetitive problems at highest speeds, they use the machine language system. With the simplified Intercom 1000 system, the entire staff uses the computer for structural design problems. This versatility also means the G-15 can be used for business data processing as well as scientific and design calculations.

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These days, a lot of bright architects and engineers who aren't afraid of new ideas, are turning the construction business upside-down. Everywhere one looks, new techniques, new materials, daring new concepts, are changing the face of America. Yet, as every practical contractor can tell you, all of these new-direction ideas are firmly based upon the proven strength and dependability of steel.

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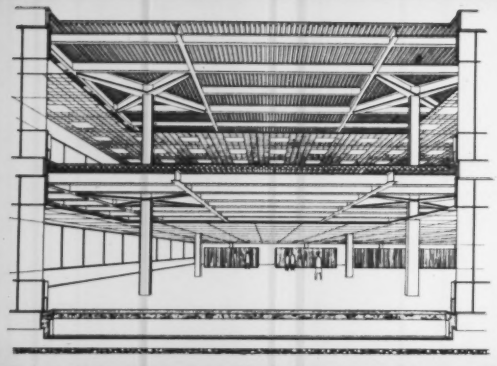
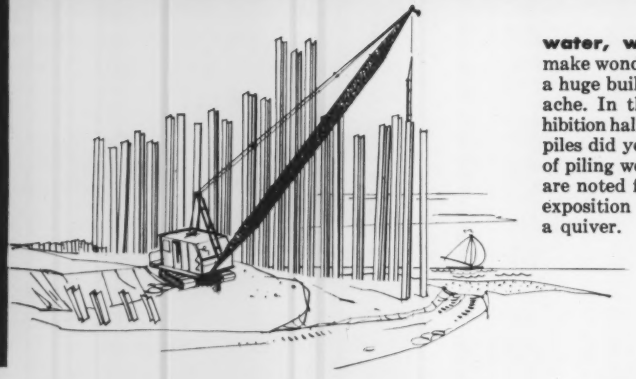
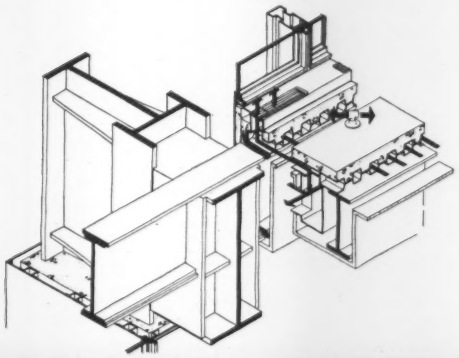


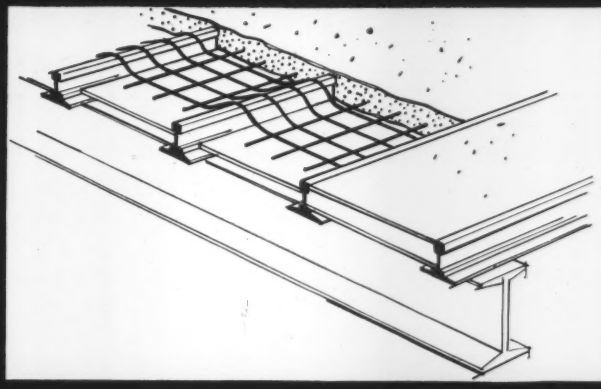
umbrella cross heads speed construction—add interesting design note—For this handsome and highly utilitarian structure, the key to the structural steel system was unique cross heads made up of Inland Wide Flange Beams. Welded into an umbrella-like design they were prefabricated into single units. On the job each unit was fastened to a supporting column using standard connections with a minimum of field welding. 36 such units were used per floor with 35 feet between supporting columns, thus providing 35-foot clear span square bays throughout. Interesting also, is the resultant 17½ foot cantilevered overhang around the entire perimeter.



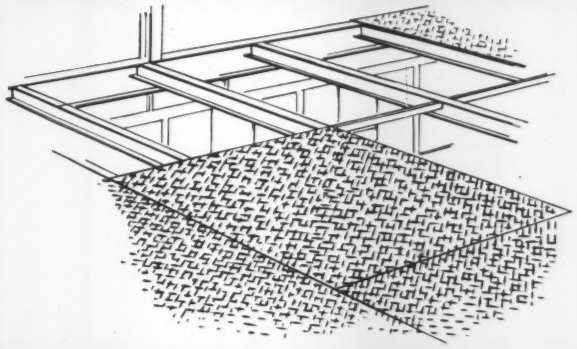
water, water, everywhere! Sand shores make wonderful bathing beaches, but anchoring a huge building in such material can be a headache. In the construction of an enormous exhibition hall right on the lakefront Inland bearing piles did yeoman service. More than 6,000 tons of piling were used and though the Great Lakes are noted for the fury of their storms, the new exposition center will ride them out without a quiver.



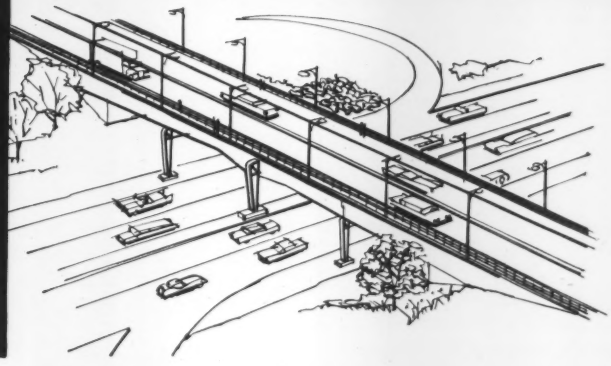
unique solution to a building frame problem—This special "torque" joint was the answer to a number of problems in the construction of a building frame where wind load was an important factor. The joint distributed the load between columns and spandrels as well as distributing both live and dead load between columns and girders. Fabricated from Inland Steel Plate at the same time as the vertical supporting columns, the "torque boxes" made field connection with girders a quite simple job. Note also the cellular floor construction—an Inland solution to the problem of handling phone, heating, cooling, utility ducts of all kinds.



weight-saver for short-span roofs... Inland sub-purlins—Inland sub-purlins are especially designed to provide a lighter, more efficient member for shorter-span roof construction. In addition, they make a real contribution to the modern good-looks so evident in today's construction. Installation is fast, easy, and entirely without waste, for Inland sub-purlins are cut to the length required for the specific roofing job. Mill painted, ready for clipping or welding to the purlin member, they're ideal for gypsum, aggregate or grout fill—all types of pre-cast or poured roofs.



new way to take advantage of prefabricated floor plate—The inherent strength of versatile Inland 4-Way Safety Plate permits its use as an integral part of the supporting structure. Used everywhere as a long-lasting material for floors, walls and stairs in industrial plants and institutional buildings, 4-Way Safety Plate is here used as part of the supportive framework. ¼ inch floorplate was used and a remarkable design span of 48 inches between centers was achieved. Additional advantages on this job were ease of cleaning and maintenance, fire safety, and slip-proof protection for future tenants and their employees.



how to stretch a girder for 500 feet—Inland Plate and Structural steel is doing its bit to make the nation's network of superhighways a reality. To span an overpass under construction in the very heart of a huge metropolitan city, Inland prefabricated sections for the enormous girders. Fifty such sections ranging from 80 feet to 120 feet in length and tapered 4½ feet to 7 feet in height were built-up from Inland plate, transported to the site where they were welded into giant girders stretching for more than 500 feet to support multiple-lane roadways.

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(Agency)

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

Men Available

CITY ENGINEER, A.M. ASCE, B.A., B.S.C.E., Registered—New York State, age 33. Experienced in municipal engineering including public works, zoning and building codes. Location desired, New York, New Jersey and Connecticut. C-494.

DESIGN ENGINEER (structural and hydraulic design), A.M. ASCE, C.E., age 30. Six years of experience in structural and hydraulic design of hydroelectric structures, two years of experience in design of commercial and industrial structures and foundations. C-495.

CONCRETE SPECIALIST, M. ASCE., Registered P.E. (three states). Wide background in quality control of construction materials, especially all facets of concrete and concreting materials in airfield, highway and dam construction, domestic and foreign. Programming, coordinating, and implementing sampling, testing and inspection; proportioning mix designs; training technicians and inspectors; supervising quality control of construction materials. C-497.

HIGHWAY DESIGN ENGINEER, A.M. ASCE, B.C.E., age 31, Registered P.E. in Pennsylvania. Seven years' experience in all phases of highway design and feasibility studies. Location desired, northeastern U. S. or Foreign. C-498.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E. and M.S.C.E. (Hydrology), age 27. Specialist in hydrology, hydraulics, water resources. One year as instructor in hydraulics, fluid mechanics, hydrology, sewerage; one half year as research assistant in hydrology; two years as field and design engineer with consultant in municipal engineering, land surveying, light construction; two years as topographic surveyor with U. S. Army in Libya. Location desired west of Rockies or Northern Midwest. C-995-Chicago.

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., age 39, Registered C.E. Three and a half years' experience on design of crushing plants and cement plants; three and a half years' on design of mill buildings and shaker and mine structures; three and a half years' on design and construction of highways. Location desired, Midwest. C-998-Chicago.

CIVIL ENGINEER, F. ASCE, B.S. in Industrial Engineering, registered engineer, age 51. Twelve years in engineering management, plus sixteen years on engineering investigations, economic analyses, project planning, construction planning, and construction; flood control, navigation, multiple-purpose projects. Particularly versed in site selection, master planning, construction and operation and maintenance of air field. C-999-Chicago.

SOILS AND GEOLOGICAL ENGINEER, A.M. ASCE, A.S., B.S., M.S., R.P.E., age 29. One year experience in highway soils engineering in construction, field and laboratory; one year experience in geological engineering-mining; one year experience in petroleum geology and editing of technical publications; two years' experience in aerial photography and interpretation of same. Approximately one-half of experience in supervisory capacity. Excellent record of ability. Location desired, South or Midwest. C-1002-Chicago.

PROJECT ENGINEER, A.M. ASCE, C.E. Louisiana Civil Engineer License, age 30. Ten years' diversified experience. Qualified in Federal Civil Service, GS-13. Now employed as civil project engineer in large petrochemicals plant. Solid design and estimating background, chemical mining, can supervise men, will travel. $750 per month. Location desired, overseas, Western United States. S(M)-1911.

GENERAL CONSTRUCTION AND MUNICIPAL ENGINEER, A.M. ASCE, C.E., age 28. One year experience as office-field engineer, including bids for bridge, highway and subway contracts, engineering studies, survey, draft, cost and progress reports, estimates, tronic sounding and drafting for dredging operations, layout piers and cofferdams; for construction companies; and two years' on contract writing, estimates, costs and progress reports, material handling, inspection on construction for oil company. $8,000. Location desired, West, Foreign. S(M)-1193.

STRUCTURAL DESIGNER, F. ASCE, C.E., Registered Architect and Civil Engineer in California, age 46. Twenty-five years of progressive experience, surveying for research engineer on streets, bridges, flood control, water works; structural design of buildings, bridges, wharves, industrial plants; architect on commercial and multi-story office buildings. $800 per month. Location desired, California. S(M)-851.

SANITARY ENGINEER AND EDITOR, M. ASCE, Licensed Civil Engineer in California, age 39. Five and one-half years involved in specifications supervision, inspection of fabrication and construction of superstructure and roadway of bridges, contract administration for government; two years on civil, mechanical design of hydraulic systems, structures, sanitary and drainage systems, earthwork, dams for industrial designers; two years as research engineer on construction of water tank and pumping stations, construction of pipelines, tunnels, reservoirs for water distribution. $800 per month. Location desired, San Francisco Bay Area. S(M)-623.

MANAGER AND CONSULTING ENGINEER, F. ASCE, age 57. One and one-half years as heavy construction advisor in Far East, management, cost control, plan, schedule, plant layout, methods for government agency; eleven years as construction superintendent of public works, townsite expansion, airbases, general building in foreign and domestic construction for contractors. $15,000. Location desired, Foreign, West Coast. S(M)-1037.

MUNICIPAL ENGINEER AND DESIGNER, A.M. ASCE, C.E., age 37. Eight and one-half years on design, construction and maintenance of petroleum pipelines and facilities for oil company, two years' draft, design streets, sewers, bridges for municipality. $9,400. Location desired, Midwest, West. S(M)-940.

STRUCTURAL ENGINEER AND SALESMAN, A.M. ASCE, C.E., age 31. Eight years' on various phases of structural engineering, civil and mechanical applications, including one and one-half years on construction. One year specialty sales. $9,500-12,000. Location desired, Southern California. S(M)-928.

DESIGNER AND CONSTRUCTION ENGINEER, F. ASCE, M.S.C.E., age 38. Twelve years' in charge of design, drawings, specifications on bridges, roads, buildings for consulting engineers. $900 per month. S(M)-835.

DESIGNER AND CONSULTING ENGINEER, A.M. ASCE, C.E., age 43. Two years' on design of highways, drainage for consultants, five and one-half years' as field engineer on design, layout, highway survey, pipelines, subdivision, buildings, railroads for consultants and contractors, one year on layout tunnel construction, materials and payroll for contractor. $750 per month up. Location desired, California or Foreign. S(M)-888.

INDUSTRIAL DESIGNER, A.M. ASCE, C.E., age 31. Four and one-half years' on design, layout, material-handling problems, equipment recommendations, specifications, plant layout, survey, costs for commercial fertilizers, petrochemicals, plastics; chemical company; one year survey on municipal engineering. $700 per month. Location desired, West, Southwest, Foreign. S(M)-819.

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DESIGN — Structural, soils mechanics, earthwork, hydraulic, estimates and specifications

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TECHNICAL EDITOR

Civil engineering graduate, in his twenties, wanted for position as assistant technical editor. Some experience is desirable but can be weighed against other important attributes such as innate ability to recognize good English and to deal diplomatically with fellow engineers and authors.

Recent graduates and discharged servicemen with exceptionally good references will be considered. Beginning salary is dependent on qualifications. Liberal vacation, sick leave, hospitalization, and retirement plans.

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New York 18, New York

Positions Available

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

SANITARY ENGINEERS. (*a*) Sanitary engineer, graduate, with a minimum of ten years' experience in preparation of reports and detail design of water distribution systems and water treatment plants; sewer collection systems and treatment plants. Capable of detail design and supervision of small group of engineers engaged in sanitary engineering work. Registered engineer or capable of obtaining engineer's license. Salary, $7,500-10,000 a year. (*b*) Sanitary engineer, graduate, with a minimum of two years' experience in detailing water and sewer work and capable of some phases of the design of such projects. Salary, $6,000-7,200 a year. Location, Georgia. W-7854.

CIVIL ENGINEERS. (*a*) Senior highway engineer, experienced in design of modern highways to head highway design section of small consulting firm. Should have talent for original planning and a good personality for client relationships. Excellent opportunity. Salary open. Location, central New York. (*b*) Structural engineer for design of industrial structures, bridges and other civil engineering projects. Small reputable engineering office. Work very diversified. Salary commensurate with experience. Company pays placement fees. Apply by letter giving description of training, experience prior salaries. Location, upstate New York. W-7901.

CIVIL ENGINEERS. (*a*) Highway design engineer with experience or background in soils engineering, young, Masters in soils engineering, with at least four or five years' experience in highway design. (*b*) Bridge designer with at least three or four years' experience. (*c*) Civil engineer, graduate, with one to two years' experience in general civil engineering. Salaries commensurate with experience and capabilities; fringe benefits. Location, Connecticut. W-7908.

ENGINEERS. (*a*) City engineer, college graduate, with four years of experience, for an attractive and rapidly growing community of 52,000. Salary open. (*b*) Planning director, degree in landscaping architecture, civil engineering or urban planning. Salary open. Location, Ohio. W-7922.

ASSISTANT TOWNSHIP ENGINEER, age 30-40, graduate civil; either registered in New Jersey or able to secure registration. Should have several years of field and office construction experience, preferably with some municipal work. Salary, $8,000-$10,000 a year. Location, Essex County, New Jersey. W-7931.

COUNTY ENGINEER, registered P.E. in Florida, experience in the design and construction of roads, bridges, and drainage facilities. Must have administrative ability and experience. Salary open. Location, Florida. W-7939.

SANITARY ENGINEER, capable of responsible charge of investigations, reports and design for growing consulting sanitary engineering firm. Minimum of ten years' experience. Excellent opportunity for advancement. Submit complete resume in confidence. Salary commensurate with qualifications. Location, Boston, Massachusetts. W-7944.

DESIGNERS, civil, mechanical, electrical or chemical engineering graduates, with experience in the design of industrial plants and process facilities for engineering and contracting organization. Salaries open. Location, northern Ohio. W-7950.

TECHNICAL SECRETARY, young, graduate engineer, having at least two years of experience, for a cooperative research organization. Opportunities for advancement and experience in research writing and publications and contacts with outstanding scientists and engineers. Location, New York, N.Y. W-7996.

SOIL AND MATERIALS ENGINEER, graduate civil, with M.S. degree and minimum of five years' experience in all phases soil engineering and materials testing, to head laboratory. Salary, $10,000-12,000 a year, plus $200 a month living expenses; one transportation-paid stateside vacation. Apply by letter stating education, experience and references. Three-year port job in South America. F-7999.

HIGHWAY ENGINEERS. (*a*) Senior civil engineer, highway, New York State Professional Engineers license or eligible for license, with six years of responsible experience in civil engineering, two of which must have been in the design of major highway projects; and two additional years in either design or supervision of construction on such projects. Salary, $7,580-9,740 a year. (*b*) Assistant civil engineer, highways, New York State Professional Engineers license or eligible for license, graduate civil, with three years of field and office experience in civil engineering, one of which must have been in the design of highways and appurtenances. Salary, $6,230-7,990 a year. Location, New York Metropolitan area. W-8002.

SENIOR CIVIL ENGINEER, Structures, B.S. or M.S. in civil engineering, New York State Professional Engineers license, or eligible for license, with from five to six years of experience, three of which must have been in the design of structures and one in supervision of construction of such projects. Design and supervision of construction must have been in connection with sewage treatment plants, bridges or public buildings. Salary, $7,580-9,740 a year. Location, New York Metropolitan area. W-8003.

ASSISTANT SCIENTIST—Ice: C.E., M.E. or Physics. Teaching experience in materials, particularly experimentation in fields for which electromechanical instruments and equipment must be designed and built. Well experienced in mechanical properties of ice in field and lab and reduction of data and analysis. Applied mechanics desirable. Experienced in cold climate and geographical area other than metropolitan. Prefers single men. Advancement to faculty position may be expected. About $7,200, plus food, housing, clothing, transportation. S(P)-4743.

DESIGNER, C.E., age open, experienced in complete design operations in a structural consulting office. Able to handle design, drafting, dealing with specifications with minimum amount of supervision on industrial type buildings, warehousing, factories. To $800 per month. Location, San Francisco. S(P)-4739.

ESTIMATOR, age 30-45, contractor background. Top-notch estimator, about ten years' experience with large building construction firms. Able to handle bids from preliminaries to final stage rapidly. For general contractor. $700 per month. Location, San Francisco. S(P)-4733.

DRAFTSMAN, with architectural office background, under 50. Top flight man to oversee preparation of working drawings, write specifications, run an office, meet clients, supervise progress of work on commercial, industrial, schools, churches and shop buildings. Should be able to work on board when necessary. For an architect. $700 per month. Location, San Francisco. S(P)-4732.

ASSISTANT DISTRICT ENGINEER, C.E. or M.E., California Registration, past experience in performing difficult field and office work in hydrology, hydraulic, structural and highway design. Direct subordinates, prepare plans, specifications and estimates for construction and maintenance of flood control and water conservation structures and distribution system. Analyze runoff, compute peaks and volumes for water sheds, safe yields and intake rates for ground water. U.S. citizen. $725-900 per month. Location, Northern California County. S(P)-4720.

CONSTRUCTION SUPERINTENDENT, C.E., background, to 50 years old. General all-around construction supervisory experience with emphasis on multi-story steel and concrete construction. Should include work similar to missile and anti-missile bases. Should be able to handle substantial construction jobs from start to completion with minimum of reference to home office. Work in Hawaii and Pacific Ocean area. $1,000 up per month. S(P)-4714.

TRAINEE, C.E. or M.E., under 30 years old. Recent graduate, with up to one year of working experience, for intensive training program—to learn process and equipment—leading to production and management position in flour or cereal mill. Requires applicant to do heavy load of hourly-paid jobs. Applicants should have over-average grades in physics, thermodynamics, mathematics and capacity for leadership as indicated by extra-curricular activities. Preference given to persons who have worked and earned a substantial part of their way through school. $450 per month start; for national organization. S(P)-4688-R.

CHIEF ESTIMATOR, C.E. plus California Registration as Civil Engineer. Around 40 years old. Must be top-man with good record in contractor type estimates on buildings for state and government (prisons, public health buildings, offices, etc.). Must be able to take-off, extend make complete bid for large national contracting firm. Excellent opportunity. Commensurate compensation plus high level pension and profit-sharing trust. Location, San Francisco. S(P)-4694.

FIELD AND OFFICE ENGINEER, graduate engineer from accredited school with two years' experience in civil or agricultural engineering, including some field experience in water supply development and utilization. $480-600 per month. Apply by letter. Location, Northwest. S(P)-4683-R.

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News of Engineers

(*Continued from page 25*)

Meredith H. Thompson, since September 1958 acting director of the Bureau of Environmental Sanitation of the New York State Department of Health, has been permanently appointed to that post. Dr. Thompson first joined the State Health Department in 1938 as a junior sanitary engineer in the Bureau of Environmental Sanitation.

James M. Bower has accepted a position with Patchen, Mingledorff and Williams, consulting engineers, of Augusta and Atlanta, Ga., as head sanitary engineer. He goes to the firm from Lexington, Va., where he was assistant professor of civil engineering at Virginia Military Institute and a partner in Bower, Dobyns and Morgan.

Louis H. Doane, consulting engineer of Wilmington, Del., announces the formation of a new firm, L. H. Doane Associates, Inc., at 100 S. French Street, Wilmington 1, Del. **Vincent M. Boyce, Joseph E. Plotts, Jr.,** and **Willard J. Orr** are other members of the firm.

Richard E. Barnes has left the Plant Design and Construction Division of the Western Electric Company, New York, where he was an engineer to join the Perlite Institute, New York, as technical director. His new duties include supervising the Institute's research activities, and preparing technical literature and information on the various applications of perlite.

James W. Yarbrough is a new addition to Harland Bartholomew and Associates and Clark, Daily and Dietz in the Memphis office of the firms. Mr. Yarbrough goes to his new work from the University of Arkansas where he was assistant professor of civil engineering. Previously he was employed by the Arkansas Highway Department.

Glen J. Hopkins, regional engineer for the Public Health Service at Kansas City, Mo., begins a new assignment on October 4 as a consultant to the Jordan National Government under the auspices of the International Cooperation Administration. He expects to return to Kansas City in January to resume his duties with the Public Health Service.

Robert A. Hubbard, district traffic engineer for the Virginia Department of Highways at Bristol, Va., has replaced **James D. Decker** as traffic engineer in charge of the Urban Traffic Engineering Section in the Richmond Central Office. Mr. Decker is being transferred to the Virginia Council of Highway Investigation and Research in Charlottesville as research engineer.

Miguel A. Quinones has resigned as chief engineer of the Puerto Rico Water Resources Authority, after a twenty-four-year career in the planning, design and construction of irrigation and hydroelectric projects, to open his private consulting engineer office in San Juan. He is a past-president of the Puerto Rico Section.

Marshall McCord, who earlier this year was made chief engineer of Green Associates, Inc., of Baltimore, Md., has now been named an associate in the firm. Mr. McCord became connected with Green Associates three years ago as chief civil engineer.

Frederick K. Schadler became associate professor of civil engineering at Ohio Northern University on September 15. Dr. Schadler, a graduate of the University of Vienna and the University of Zurich and a comparative newcomer to the United States, designed the new $13-million Turkish Parliament building at Ankara.

Edward L. Zeltner, an engineer for the National Board of Fire Underwriters, New York City, retired this week after thirty-four years of service. For many years he was engaged in municipal survey work, and in recent years has handled building and fire prevention code work and other specialized engineering activities of the National Board.

Fred F. Lawrence recently opened an office at 937 Tacoma Avenue South, Tacoma 5, Wash., for the general practice of civil and hydraulic engineering and land surveying. Mr. Lawrence was formerly employed as project engineer for Horace J. Whitacre and Associates, professional engineers in Tacoma.

Martin W. Kehart, Rear Admiral, CEC, USN, has been named director of the Atlantic Division of the Bureau of Yards and area public works officer at Third Naval District Headquarters, New York City. He succeeds Rear Admiral **William Sihler,** who retired from active duty August 31 after thirty-four years in the Navy. Since April 1958 Admiral Kehart has been inspector general of the Bureau of Yards and Docks in Washington, D. C.

Hugh E. Mulholland, until recently sales manager for Armco Drainage and Metal Products, Inc., at Los Angeles, has joined the staff of Daniel, Mann, Johnson & Mendenhall, architects and engineers of Los Angeles, as special consultant to the firm's civil engineering and public works clients.

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Products and people, dependably serving every water and gas distribution system — for over a century!

Supplying a constant flow of water and gas to your home or your industry requires highly specialized tools and equipment.

For example, this Mueller automatic drilling machine is used to drill into mains to make new connections and to add valves while the main is under pressure — *without shutting off the flow of water or gas.* The operator needs only to check the visual indicators to see how the automatic cut is progressing.

Today, because of the dependable performance of the thousands of products developed by Mueller people for the water and gas industries, the constant, safe control of gas and water is taken for granted.

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In less than a year, Alcoa® Aluminum Beam Guard Rail has gained tremendous acceptance. Proof? Twenty-five states have already included it in their specifications. But that doesn't mean short supply, because Alcoa's foresight led to stockpiling ample quantities and planning production schedules to meet any anticipated demand.

That means you can get Alcoa guard rail right now—with all of these benefits riding on every order: *No painting*, on or after installation, in spite of corrosive attack by road salt, industrial fumes, air-borne abrasives and weather. *Maximum safety* from high-strength Alcoa Aluminum alloys. *Lasting good looks* without the expense of maintenance.

Now is the time to get the full story. Learn how Alcoa Aluminum Beam Guard Rail can stretch taxpayers' dollars on any highway by calling your nearest Alcoa sales office (listed in the Yellow Pages of your telephone directory). Or write: Aluminum Company of America, 1913-L Alcoa Building, Pittsburgh 19, Pa.

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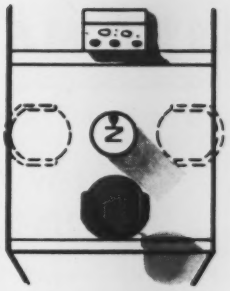
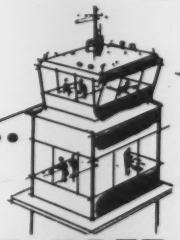
Your Guide to the Best in Aluminum Value

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV



Three quickly adjustable bucket seat positions provide excellent operator visibility



Airport Control Tower Visibility...

Seaman-Andwall

STĀ-BILT Steel Wheel ROLLERS

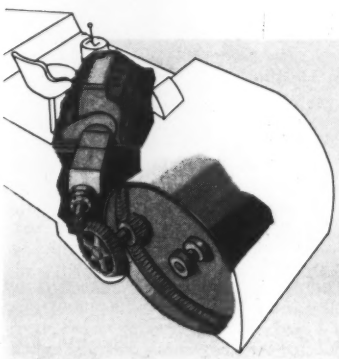
Multi-position, comfortable bucket seat on top of roller provides 360° operator vision from any one of 3 positions — ahead, behind and at both sides. It's a big feature that insures better, faster, more accurate work — especially in close quarters.

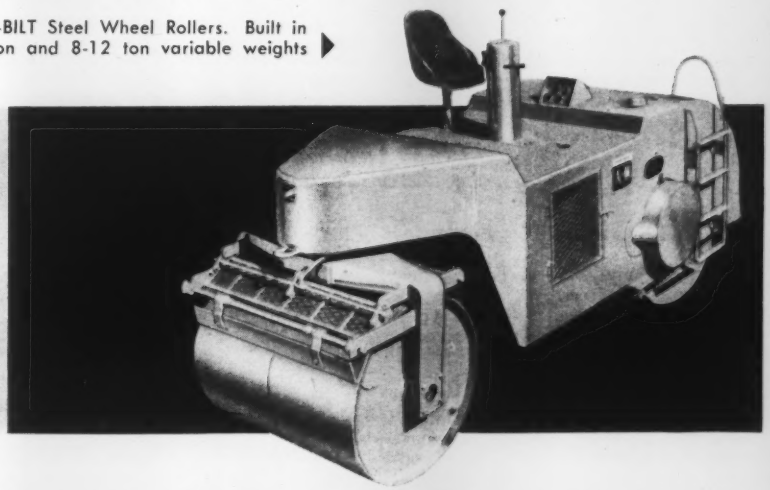
And the unique Direct-In-Line Power Train eliminates power-robbing jackshafts, countershafts, chains, belts or right angle drives . . . positive power, high efficiency and low fuel consumption at all times. All access doors can be locked . . . direction and acceleration from one control.

Engineered in two models — the 500 Series, 5-8 tons; 800 Series, 8-12 tons variable weights.

Investigate the STA-BILT rollers now. Specify them for all your steel wheel compaction — in the interest of far better work at much lower cost.

STA-BILT Steel Wheel Rollers. Built in 5-8 ton and 8-12 ton variable weights ▶





▲ Direct-in-line Power Train — the greatest advance in roller efficiency in years

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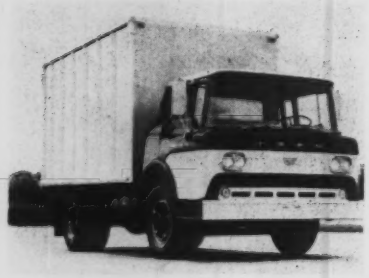
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

NEW TRUCKS FROM FORD

• ENGINEERED AND CONSTRUCTED to the highest quality standards, the company's proven 1960 heavy and extra-heavy duty truck line features greater gross vehicle weight ratings, extensive model flexibility and increased engine fuel economy, through advanced engineering design. The new line includes more than 200 conventional, tilt-cab and tandem models with maximum GVW's ranging from 22,000 to 51,000 lb and gross combination weight for tractor trailer applications from 35,000 to 75,000 lb.



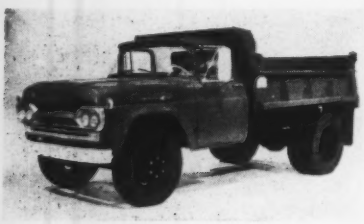
Additional Axle Selections

In the heavy and extra-heavy conventional models, F-700 through F-1100 series, the additional application of three new front axles and six rear axles, in either single speed or two speed versions, provides added model flexibility and versatility to better meet any truck operator's requirements. Maximum GVW ratings are also increased from 2,000 to 3,000 lb over comparable 1959 models, on virtually all models. Ford's heavy and extra-heavy duty tilt-cab series also offers additional axle selections for greater versatility. Availability of six added optional rear axles affords increased maximum gross vehicle weight ratings of 1,000 to 3,000 lb, and provides these models with new flexibility. The tilt-cab design provides complete engine accessibility, cutting maintenance and service operations to half the time required for cab forward type units.

• AVAILABLE IN MORE THAN 200 models in six series, the 1960 light and medium Ford trucks incorporate increased operating and maintenance economy along with greater driver comfort and improved "cab-livability."

In the light trucks, the F-100 pick-up offers increased frame rigidity for greater chassis durability and improved riding and handling characteristics, particularly on rough and secondary roads.

Typical of the new engineering advancements and special features available in the company's medium truck line is the F-600, offering a choice of 17,000, 18,000, 19,500, or 21,000 lb gross vehicle ratings with all components engineered to give best economy and durability performances at any one of these four GVW ratings.



Model F-600

Standard F-600 frames feature new, stronger construction with more rugged rear spring brackets.

• IN THE COMPANY'S Super Duty engines, the first complete series of Ford truck engines to be specifically designed for extreme heavy duty use, 1960 engineering advancements have increased fuel and maintenance economy, and durability is even greater than in the original engines —some of which have already operated more than 200,000 miles without major overhaul. Super Duty V-8 engines for extra heavy trucks include the 220 hp, 401 cu in.; the 257 hp, 477 cu in. and the 270 hp, 534 cu in.

For positive fuel feed to the Super Duty engines, the electric fuel pump is located in the fuel tank. This large capacity, submerged-type pump delivers only liquid fuel—no vapor—under pressure to the carburetor, independent of the engine's rpm's.

Improved Oil Control Rings

In all seven of 1960 Ford V-8 engines, advanced engineering improvements include double neoprene coated gaskets on the rocker covers, new oil pump relief valves, improved oil pump drive shafts, and improved oil control rings. **Ford Division of Ford Motor Co., CE-11, Rotunda Drive at Southfield Road, P.O. Box 608, Dearborn, Michigan.**

Cellular Type Insulating Concrete

A NEW CELLULAR TYPE of light-weight insulating concrete, Betocel is composed of four simple components—Portland cement, normal sand, ordinary water, and Betocel emulsion.

Betocel is filled with millions of tiny non-connecting air cells, each of which is plastically lined and is a completely sealed dead air space; its density is controllable to weights as low as 20 lb per cu ft.

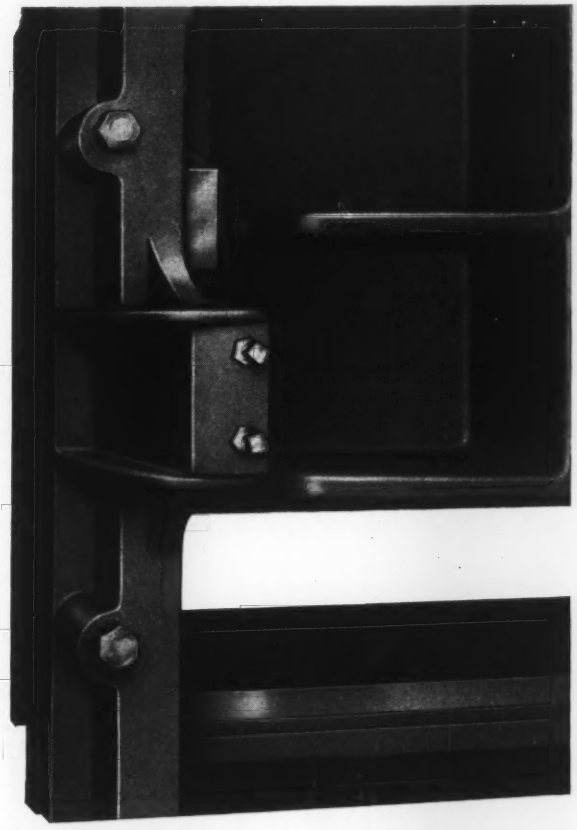
According to the manufacturer, Betocel provides outstanding insulating value, is completely incombustible, impervious to moisture penetration, sound resistant, and rot and fungus resistant. **Reflectal Corp. Architectural Subsidiary of Borg-Warner. Corp., CE-11, 200 S. Michigan Ave., Chicago 4, Ill.**

Pole Type Extension Gun

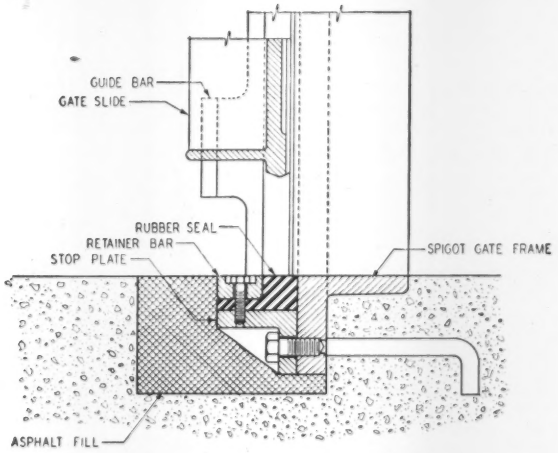
ROOF COATING AND SIMILAR heavy materials can be applied more quickly, economically and efficiently with a new pole type extension gun.

Especially designed to handle roof coatings, concrete curing mixtures, foundation coatings, black top sealers, steel tank coatings and sound deadeners, the pole gun features rugged, simple construction for trouble-free use under rugged conditions.

The air and fluid are controlled by lever handle valves, with the fluid pipe and metal air tube reinforced by clamp type spacers; the spray head is set at 45 deg angle. A special one-quarter in. internal nozzle combination sprays the heavy materials in a large, round pattern and provides uniform coverage of the desired thickness. **The Devilbiss Co., CE-11, 296 Phillips Ave., Toledo, Ohio.**



Close-up view of Armco Gate with flush bottom opening.



Detail of flush bottom opening.

Gain Increased Capacity, Flushing Action, Uninterrupted Flow..

SPECIFY ARMCO GATES WITH FLUSH BOTTOM OPENINGS

Available in various Armco Gates, flush bottom openings provide a continuous flat bottom channel with no protrusions to interfere with flow or catch debris and solids. Since only the top surface of the rubber seal is exposed, these openings are equally efficient for flow or operating heads in either direction.

You can get the flush bottom opening on all sizes of Armco Series 35-05, 55-10, 55-20, and 100-30 Gates (more than 200 different gates).

Armco Gates are also available with standard perimeter seating. Sizes range from 6-inch square or circular openings up to similar dimensions of 108 inches. They may be provided for face heads up to 100 feet; back heads up to 30 feet.

For more information on these Armco Water Control Gates for municipal and industrial applications, just fill in and mail the coupon. Armco Drainage & Metal Products, Inc., 4419 Curtis Street, Middletown, Ohio. In Canada: write Guelph, Ontario.

ARMCO DRAINAGE & METAL PRODUCTS, INC.
4419 Curtis Street, Middletown, Ohio

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(continued)

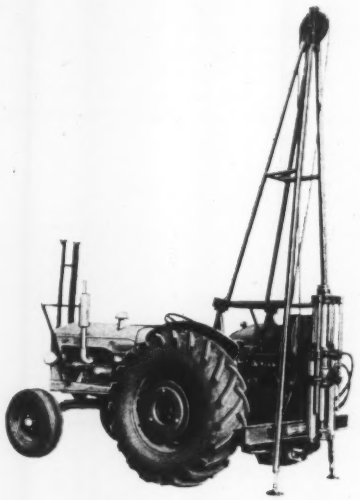
Simplified Vibrating Machine

A COMPACT VIBRATING MACHINE for rapid, on-the-job production of all standard sizes of concrete block and brick has been announced.

Easily transportable from one location to another, the machine is said to be ideal for both building contractors and concrete block manufacturers. It is equipped with either electric motor or gasoline engine—or can be operated manually. Simplified design enables anyone to operate the machine after a few minutes instruction. The few moving parts involved are standard units, replaceable anywhere. Mold boxes are furnished for special sizes and shapes. **General Engines Co., Inc., CE-11, Rt. 130, Thorofare, N. J.**

Tractor-Mounted Core Drill

TRACTOR MOUNTING IS A special application of the company's Model 40-C Core Drill. The machine in the picture is a 40-C Core Drill mounted on a diesel-powered Fordson Tractor. The unit is equipped with a Size "NW" oil-operated double hydraulic swivelhead, a four-pole derrick, and also a built-in water pump



Tractor-Mounted Model 40-C

capable of pumping either clear water or recirculated water.

The Model 40-C can be skid, trailer, or truck-mounted. The 40-CL is a special skid mounted unit with a low center of gravity to provide maximum stability when moving through rough or hilly terrain. **Sprague & Henwood, CE-11, 221 W. Olive St., Scranton, Pa.**

Direct-Drive Chain Saw

A NEW ECONOMY direct-drive chain saw called the "Buz" has been announced. Weighing only 19 lb, less bar and chain, the "Buz" has plenty of power; it will cut through 16-in. trees in 16 sec and fell trees up to 3 ft in dia. So easy to handle, a beginner can use it profitably for cutting firewood or fence post, clearing campsites, repairing storm damage, pruning and trimming, building shelters, clearing land and maintaining rights-of-way.

The "Buz" gets its power from the famous short-stroke Homelite engine. It is available with 12 in., 17 in. and 21 in. straight blades. The flush-cut handle allows trees to be felled level with the ground, eliminating unsightly and dangerous stumps. **Homelite, CE-11, Port Chester, New York.**

When You Build for Strength
Build with The Prescon System
of Prestressed Concrete

Designed for 300 lb. per sq. ft. load with 50 ft. clear span, and floor depth limit of 25 in. overall.

Structural engineers and architects now build *living strength* into heavily loaded structures with concrete prestressed by The Prescon System of post-tensioning.

Living strength concrete allows open, long span construction pleasing to the modern eye with no sacrifice in strength . . . low cost, easy building and low maintenance.

When you want to build for strength . . . and good appearance . . . call your Prescon Representative for engineering and design recommendations on using The Prescon System of prestressed concrete for long span beams and girders, lightweight decking members, poured-in-place floors and roofs that give today's ultimate in construction material strength.

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MEMBER PRESTRESSED CONCRETE INSTITUTE

Steel and Concrete Sea Wall

AN UNUSUALLY DESIGNED STEEL and concrete sea wall has been constructed along Wollaston Beach, near Quincy Bay, Mass., to prevent extra high tide flooding of residential and commercial areas.

The mile-long wall of interlocking "Z" sheet piling and reinforcement rods enclosed in concrete is part of a $2 million beachfront renewal and development project under supervision of the Metropolitan District Commission in the Boston area.

Unusually Designed

Special steel forms were used to place 3,200 cu yd of concrete. Bitumastic-covered steel piling was driven 19 to 43 ft deep, depending on soil strata. The upper 9 ft of piling, including 6 ft below sand level, is encased in concrete; this was placed in 50-ft long, 24-in. thick sections, through use of the forms, which were removed after 24 to 48 hours. Concrete was sprayed with a sealer for curing. A crawler-mounted crane aided in repositioning the steel forms. **Blaw-Knox Co., CE-11, 300 Sixth Ave., Pittsburgh, Pa.**

Lightweight Aluminum Wrench

A LIGHTWEIGHT ALUMINUM WRENCH especially designed to meet high strength requirements is now being manufactured.

The wrench is the first of its type forged wholly from aluminum bar stock to meet U.S. Standards GGG-W-651C for heavy duty strength requirements, and Mil-W-1976 for maximum safety, according to the company.

Approximately 66% lighter than malleable iron wrenches, it is made of Kaiser Aluminum alloy 2014 and is available in 10, 14, 18, 24, 36 and 48-in. long sizes with jaw capacities of 1½, 2½, 3, 4½ and 6 in.

Standard models have insert steel jaws which are replaceable. A safety wrench with non-sparking beryllium-copper jaws also is available and all models are equipped with a tension spring between the jaw head and handle—a steel spring insert for the Standard model and beryllium copper spring for the safety wrench. **Schick Products, Inc., CE-11, P. O. Box 867, Belmont, Calif.**

Portable Moisture Meter

EXACT MOISTURE CONTENT of sand, soil or any bulk material is measured instantly, automatically by a new portable moisture meter. This lightweight electronic instrument avoids costly delays and equipment downtime by taking the guess-work out of moisture content. Slung over the shoulder, it measures instantly and accurately the exact moisture content of surface or sub-surface sand, soil or any bulk material. Moisture content registers on the dial when the probe, connected by insulated cord to the meter, is plunged into the material. **C&W Sales Co., CE-11, 1490 Franks Lane, Menlo Park, Calif.**

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Aerial Surveying anywhere in the world!

In Alaska alone Fairchild has flown over 60,000 square miles of airborne magnetometer surveys...another illustration of how Fairchild crews get the job done under even the most rugged conditions.

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Good fabrication and welding properties of "T-1" Steel saved time and money in the shop and on location. Owner: The Washington Water Power Company. Engineering: Ebasco Services, Inc. Scroll cases: Chicago Bridge & Iron Co. Turbines: Allis-Chalmers Co. General contractor: Morrison-Knudsen Co.

USS "T-1" Steel cuts weight of biggest turbine scroll cases 50%

A SCROLL CASE looks like a giant sea shell. Water gushes into it from a high level reservoir. Through the conch, the water swirls in an ever-tightening spiral into the blades of water turbines. Because the cross section of the spiral passage diminishes, the water pressure and velocities are built up for efficient power generation. Four of these scroll cases, the largest in the United States, have been built from USS "T-1" Steel by the Chicago Bridge & Iron Company. They are installed in the Noxon Rapids Dam, an $87 million project now under construction by the Washington Water Power Authority to harness the waters of Clark Fork River. The dam is located on the site of a prehistoric lake in western Montana.

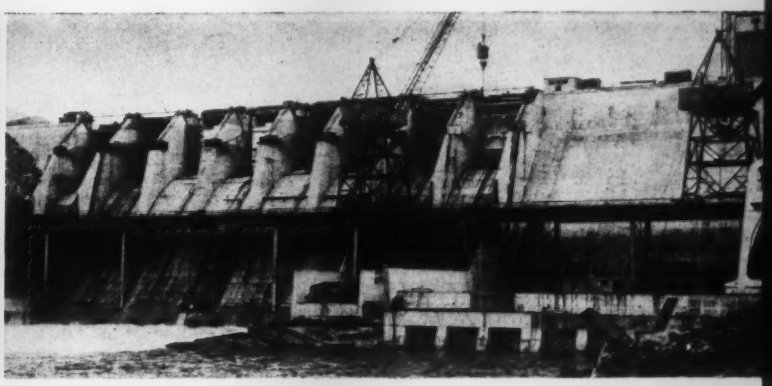
Because of the fierce pressure and erosive action of the water, it was obvious that a very strong, abrasion-resisting steel was required. USS "T-1" Constructional Alloy Steel not only met these requirements, but permitted a reduction of about 50% in plate thickness.

COST SAVINGS. By using USS "T-1" Steel, there was substantially less weight of material to ship across the country. Weld time and weld metal were reduced. Foundations could be made smaller.

This job points up the economies possible with the use of USS "T-1" Steel: lighter weight, greater strength, weldability and resistance to impact abrasion. Write for our "T-1" Steel book containing complete information. United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks

Scroll cases built with USS "T-1" Steel to obtain maximum strength with the least weight. Largest diameter is 24 feet with a speed ring about 28 feet in diameter.



Noxon Rapids Dam a new $87,000,000 power project by the Washington Water Power Company to harness the waters of Clark Fork River in western Montana.

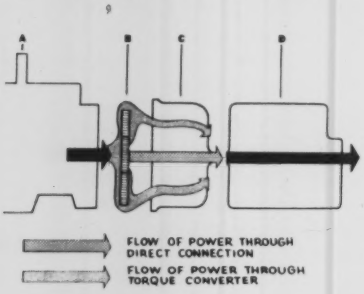
United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

Power Shift Transmissions

POWER SHIFT TRANSMISSIONS, each of which features an exclusive new concept in the transmittal of tractor power, are now available on Caterpillar D8 and D9 Tractors. Providing instantaneous, one-lever control of gear shifting without interruption of power and momentum, they are built to withstand the demanding conditions of tractor service.

By a unique utilization of planetary gear versatility, introduced to the industry on these machines, tractor performance is provided which combines the best features of both direct drive and torque converter power trains. Heart of the new power-tailoring arrangement is a planetary gear set, driven integrally by the engine flywheel, which transmits ⅓ of the engine torque directly to the transmission input shaft, and the remaining engine torque through the torque converter. Horsepower of both machines has been increased to give an additional boost to productivity.



On the operator's deck, one range selection lever now takes the place of the flywheel clutch lever, gear selection lever and forward-reverse lever, meaning reduced shifting time, effortless and simplified shifting. **Caterpillar Tractor Co., CE-11, Peoria, Ill.**

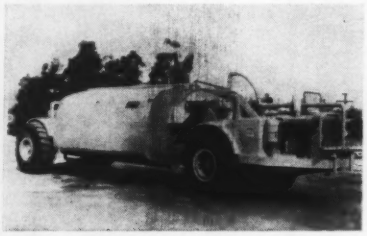
Dual Air Sander-Drill

OPERATED AS A SANDER, the Dual Purpose Sander-Drill uses standard 4-in. discs or buffers—does automotive body sanding, sheet metal buffing, deburring and light weld scaling, wood sanding, and rust or paint scaling. Used as a drill, the unit takes any standard drills up to ¼ in., is recommended for light sheet metal, galvanized, aluminum sheet or tubing, lucite, transite, asbestos sheet, and other plastics. Directed air exhaust blows away dust and chips as operator works.

The Dual Purpose uses the metering trigger so operator can control blows per minute from 0 to 6000 rpm. According to the manufacturer, this feature is especially important where slow speeds are needed for drilling aluminum sheet or tubing, galvanized, or plastics. **Superior Pneumatic & Mfg., Inc., CE-11, 13800 Enterprise Ave., Cleveland 35, Ohio.**

Semi-Trailer Sprinkler Tank

DESIGNED FOR USE BEHIND Caterpillar DW-21 and DW-20 tractors, the new larger capacity Model STT-80 Semi-Trailer Sprinkler Tank has front, rear and gravity spray bars, which are capable of delivering 1,500 gpm with a spray swath of 55 ft. Nozzles on front and rear pressure bars are manually adjustable for regulating direction of spray and volume of flow. Air-actuated valves, operated from the driver's position, control water flow.



Model STT-80

Two loading systems are offered: either from an overhead standpipe through a top inlet, or a suction valve arrangement. Large earth-mover tires provide adequate flotation for operation in soft earthfills. **Southwest Welding & Manufacturing Div., Yuba Consolidated Industries, Inc., CE-11, 3201 W. Mission Road, Alhambra, Calif.**

New Process Protects Aluminum

A NEW PROCESS HAS been perfected to protect extrusions. Called Anocote, the development eliminates superficial corrosion of aluminum. Special production operations and metallurgical techniques are required for the treatment.

Because the process protects the metal during routine shipping, storing, and handling, fabricators who anodize or etch their extrusions report that the surface of

(*Continued on page 124*)

Specify S&L "OXIGEST" SEWAGE TREATMENT PLANT

FACTORY-BUILT TREATMENT PLANT FOR SMALL SUB-DIVISIONS

The Smith & Loveless "Oxigest" is a low-cost, factory-built sewage treatment plant for small sub-divisions, schools, motels and factories. It has been carefully engineered for dependable treatment without requiring a skilled operator. Built of the finest materials, the "Oxigest" will provide a permanent plant with minimum annual maintenance.

This complete factory-built unit is available in 27 standard sizes to cover a wide range of applications. It is easily and quickly installed after delivery to the job site on special Smith & Loveless trucks.

Write today for free data manual containing design notes, selection charts, dimension drawings and specifications. Write Department 80

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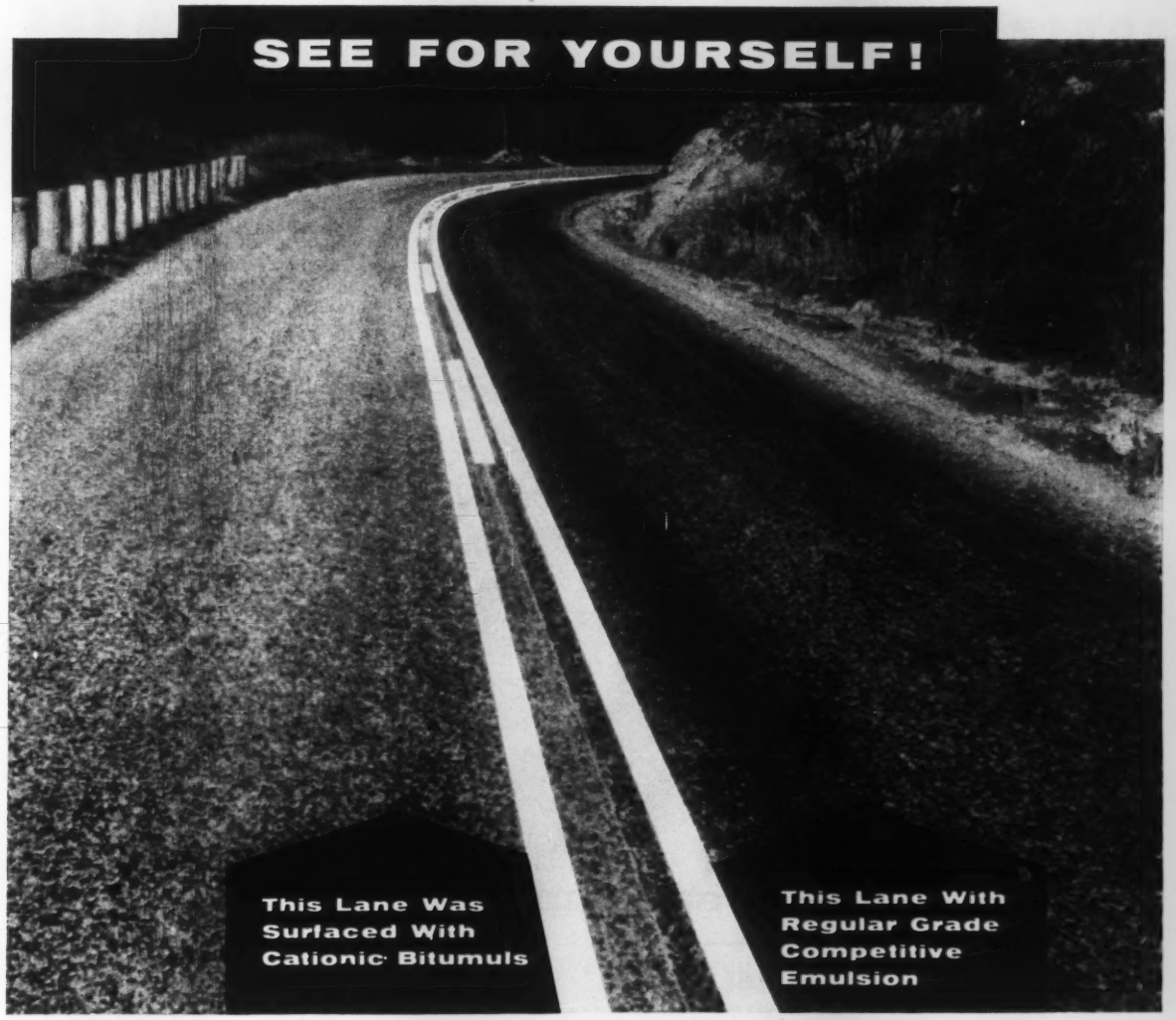


You Get BETTER Surface Treatments With CATIONIC BITUMULS

This photograph gives visible proof of the superior performance of Cationic Bitumuls. The picture was taken on a 25-mile test section of highway in North Carolina.

Based on the success of this job, Cationic Bitumuls is being used for extensive surface treatment work throughout the State during the current construction season.

In every test made to date—whether in laboratory or field—Cationic Bitumuls has shown two outstanding qualities:

1. Unusual ability to hold aggregate, even "difficult" types.
2. Rapid initial set that minimizes damage from early rainfall.

If you haven't tried this new material, call our nearest office today and arrange to test Cationic Bitumuls on your next pavement construction or maintenance job.

American Bitumuls & Asphalt Company

320 MARKET STREET • SAN FRANCISCO 20, CALIFORNIA

Atlanta 8, Ga. Portland 8, Ore. Perth Amboy, N. J. Mobile, Ala. Oakland 1, Calif. Baltimore 3, Md.
St. Louis 17, Mo. Inglewood, Calif. Cincinnati 38, Ohio Tucson, Ariz. San Juan 23, Puerto Rico

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

(continued)

Anocote aluminum is exceptionally smooth, uniform, and free of defects after anodizing or etching.

The appearance of the new finish does not alter the natural color of aluminum. Anocote may also be used as the final surface of the metal. Initially, the process is being supplied by the company on extrusions in alloy 6063 only. **Harvey Aluminum, CE-11, 19200 S. Western Ave., Torrance, Calif.**

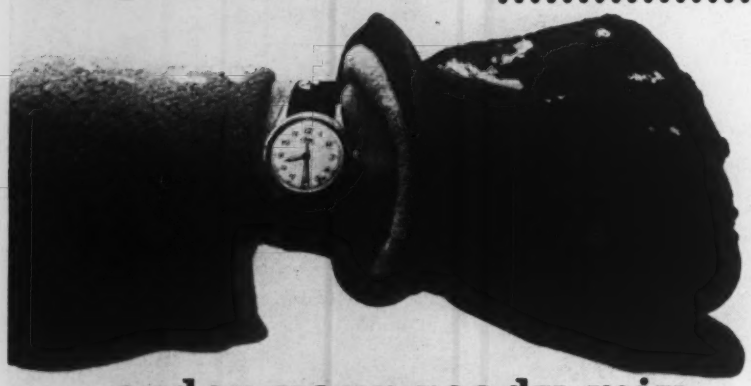
Measuring Wheel

ACCURATE AND DEPENDABLE measurements from a measuring wheel that can be rolled over even the most irregular and uneven terrain is now available. Of particular interest to engineers and contractors, the new measuring wheel can be operated by one man, registering measurements to ½ in. on one side of the disc wheel and tenths of a foot on the other.

The sturdily constructed Rolatape Model #415 has a wide neoprene tire that provides positive traction under all conditions. Equipped with an automatic brake and a built-in stand, the #415 handle folds compactly when not in use.

One man can roll it along to measure up to 100,000 ft. Curves and contours are measured as easily as straight, flat surfaces, another example of the tremendous versatility of the #415. It can even be operated from a car window when driving at low speeds. **Rolatape Inc., CE-11, 1741 14th St., Santa Monica, Calif.**

Keep on schedule all winter



–order your ready-mix

SPECIAL WINTERIZED

with SOLVAY CALCIUM CHLORIDE

Ask your ready-mix supplier to include 2% of Solvay® Calcium Chloride,* with heated water and aggregate, in your ready-mix. Keep close to schedule at *any* temperature with this "Special-Winterized" mix that . . .

Reduces overtime finishing. Sets faster. **Speeds form removal.** Develops high early strength. **Reduces protection time** up to 50%. **Reduces delay** between operations. **Adds safety** through extra cold weather protection.

In addition, your concrete has 8 to 12% greater ultimate strength. And it's more workable. You use *less* water-to-cement, so you get denser concrete—more resistant to moisture and wear.

*Speeds but does not change the basic action of portland cement. This use of calcium chloride is approved by Portland Cement Association, American Concrete Institute, Calcium Chloride Institute, leading highway departments.

Write for *Solvay's 38-p. "The Effects of Calcium Chloride on Portland Cement."*

Allied Chemical

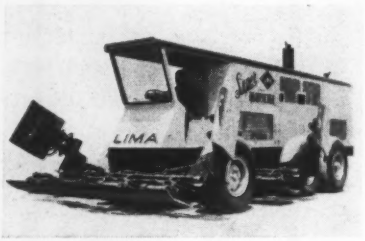
SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

SOLVAY branch offices and dealers are located in major centers from coast to coast.

Super-Roadpacker

THIS ROADBUILDING GIANT, the Super-Roadpacker, will reduce by 50 to 75% the time required to condense granular materials to smooth, solid, long-lasting foundations for concrete and bituminous pavements and then will double the capacity of the fastest vibratory compaction machine previously available, according to the manufacturer.

Compaction is accomplished by two 15-ft rows of vibrating shoes, arranged in tandem; one row of six shoes, is mounted behind the front axle. Each vibrating shoe is fully sealed against sand and dust, permitting the shoes to operate at full efficiency even if buried in loose sand. End shoes on each of the Super-Roadpacker's



Powered by Two Engines

two cross tubes can be raised to reduce the machine's working width for use between forms or in other restricted areas.

The Super-Roadpacker is powered by two engines, gasoline or diesel, according to customer preference. One engine is used exclusively to drive the vibratory system's two 120 gallons per minute hydraulic pumps—one for each set of six vibrators. Provision is made in the hydraulic system so that each pump can drive either or both sets of vibrator motors. The second engine is used to propel the vehicle. Either a gasoline or diesel engine is available for this purpose. The propelling engine is connected to two transmissions which, in turn, connect to Timken axles. **Baldwin-Lima-Hamilton Corp., Construction Equipment Division, CE-11, Box 421, Lima, Ohio.**

Shhhh!

Putting up steel in a hospital or school zone?

Specify high-strength bolting. Tightening with a pneumatic wrench (all that's needed) is far less noisy than a riveting gun. It's quicker than riveting too, so there's less "noise time." Safe? With high-strength bolting there's no fire hazard, no danger of injury from tossed rivets. And every joint is tight—*permanently*. Bethlehem supplies a full size range to meet every construction need. Each bolt meets the requirements of ASTM Specification A-325. Plan to use Bethlehem High-Strength Bolts on your next job.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Space Heaters

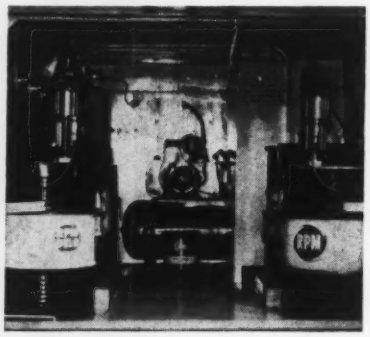
THE INTRODUCTION OF an all new line of space heaters for the coming winter season has been announced. The three oil fired sizes offer a choice of 125,000 btu, 250,000 btu and 500,000 btu capacities. All models are portable and are mounted on rubber tired wheels.

The units feature stainless steel combustion chambers with gun type atomizing pressure burners. Continuous ignition supplied by a 10,000 volt transformer insures instant ignition. Either kerosene or No. 2 fuel oil can be used and fuel tanks are an integral part of the heaters. Standard electrical connections—115 volt, 60 cycle are provided. **Aeroil Products Co., Inc., CE-11, 69 Wesley St., South Hackensack, New Jersey.**

Portable Lubrication Rigs

AS ONE OF THE MOST important operations in the construction, mining and quarrying industries today is to service "on-the-job" equipment with minimum loss of down time, equipment owners are using portable lubrication rigs, which can be designed and installed on small pick-up, large flat-bed or enclosed van-type trucks.

A portable lubrication rig is equipped with an air compressor, six air operated drum pumps, 400 lb or 200 lb, two for high pressure operations and four for low pressure jobs, which are attached to either 55 gal drums or fabricated tanks. A bank of spring loaded hose reels, equipped with 35 ft of flexible hose will allow the operator to handle any job outside of the rig. In most cases these rigs are equipped to dispense motor and gear oils, and light or heavy grease for chassis and track roller lubrication. Units for gasoline, Diesel fuel, water and air can also be installed in the rig for meeting the operator's requirements. **The Cypher Co., CE-11, 1201 Washington Blvd., Pittsburgh 6, Pa.**



Minimum Loss of Down Time

Dewatering Well Point

A NEW SELF-JETTING dewatering well point that will penetrate semi-consolidated material such as clay and hardpan and a light-weight, quick-connecting swing joint system has been developed.

The "Green Head" dewatering well point is an all-welded continuous "V" slot well screen with a special internal drop tube and sleeve valve that provides a more positive jetting action than heretofore possible with conventional self-jetting dewatering points.

During the jetting operation, the sleeve valve closes off the inlet ports near the bottom of the drop tube and directs more than 90% of the water force

(*Continued on page 138*)

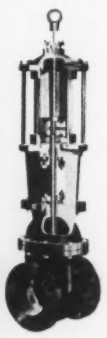
A CUP OF WATER

"'Tis a little thing," the poet says, "to give a cup of water." Yet water, an absolute necessity even in the most primitive society, has had to be rationed in over 1,000 prosperous U. S. communities in the past 5 years. Rainfall has been normal. But water use has increased much faster than improvements in water distribution facilities. Suburban development means more footage of water main per customer.

Some 60% of the water utilities in prosperous U. S. need major improvements now in their distribution systems. For the next 20 year period the U. S. Department of Commerce estimates water works and sewerage works construction requirements at over $41 billion, which is about equal to the total estimated replacement value of existing facilities. This will require construction expenditures at approximately double the current rate.

So, "to give a cup of water" in these modern times has ceased to be a little thing. Your water works superintendent knows the technical side of the problem. But he needs the moral support of his water consumers.

This series is an attempt to put into words some appreciation of the water works men of the United States.



M&H VALVE AND FITTINGS COMPANY
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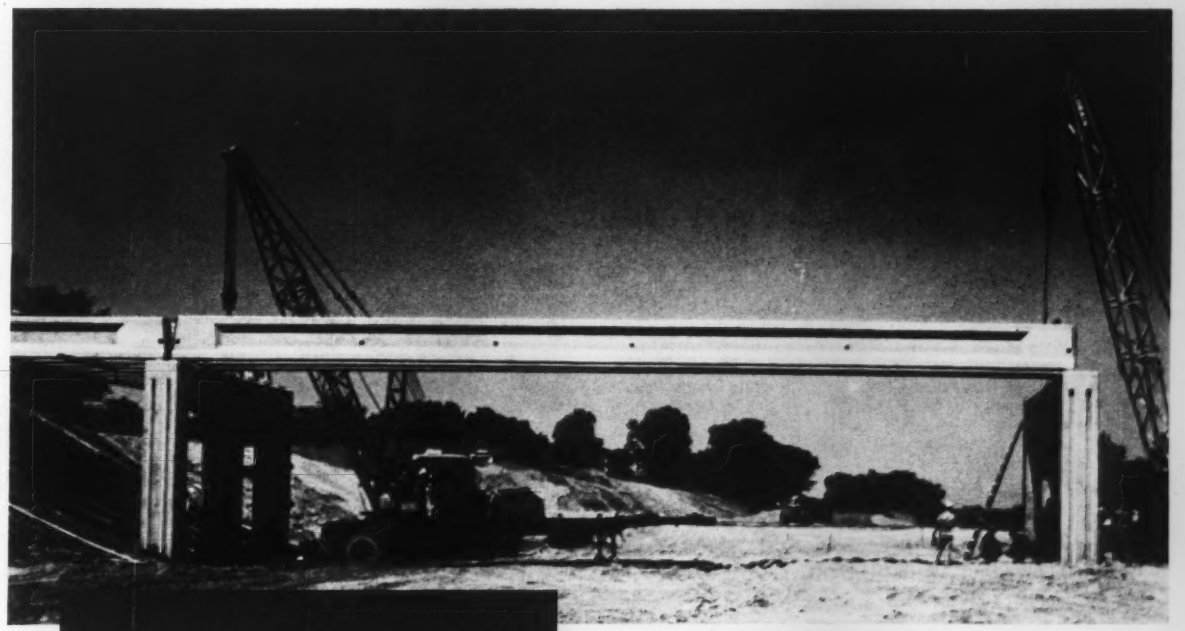
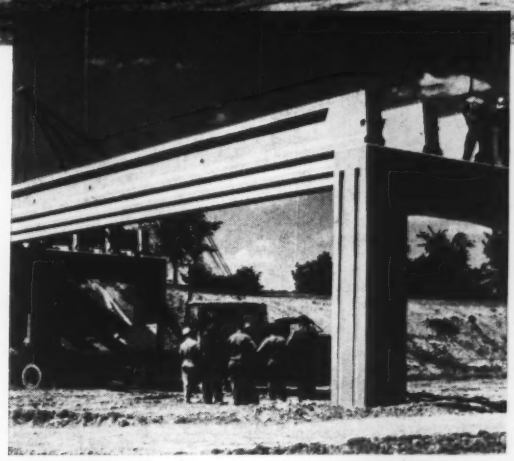
PRESTRESSED CONCRETE BEAMS
for Minnesota Highway Bridge at Fort Snelling





Two cranes place prestressed concrete beams for this new bridge on State Route No. 5, Fort Snelling, Minnesota. Fourteen 78′ 8″ and fourteen 34′ 3″ beams were used. The larger units weighed 24 tons each.

OWNER: Minnesota Highway Department

CONSULTING ENGINEERS: Mayeron Engineering Company, Minneapolis, Minn.

GENERAL CONTRACTOR: Ashbach Construction Company, St. Paul, Minn.

CONTRACTOR FOR CONSTRUCTION OF BRIDGE: Sheehy Construction Company, St. Paul, Minn.

MANUFACTURER OF PRESTRESSED BEAMS: Prestressed Concrete, Inc., Roseville, Minn.

In Minnesota, as in every other section of the country, more and more highway bridges are being built with prestressed concrete beams. Low first cost, quick delivery, ease and speed of erection and minimum maintenance costs are the reasons for the increasing number of bridges of prestressed design.

Beams for this Minnesota Highway Bridge on State Route No. 5 at Fort Snelling were manufactured by Prestressed Concrete Inc., Roseville, Minn. Using Lehigh Early Strength Cement and steam curing, the concrete in these beams reached 5,000 PSI in 12 hours. As a result, the manufacturer gained maximum production efficiency and economy through early removal of units and quick reuse of casting beds.

This is typical of the advantages of prestressed concrete and Lehigh Early Strength Cement in modern concrete construction.

LEHIGH CEMENTS

LEHIGH PORTLAND CEMENT COMPANY, ALLENTOWN, PA.

through the cutting shoe. When the well point is pumped, a ball check closes off the bottom, and the sleeve valve opens to permit the soil to be dewatered down to the bottom of the screen without the well point breaking suction. **Edward E. Johnson Inc., CE-11, 315 N. Pierce St., St. Paul 4, Minn.**

Expanding Earth Anchors

EXCLUSIVE FEATURES OF THE GREATLY enlarged line of all steel Grip-Tite expanding earth anchors include: Grip-Tite wing dimples, and deeply embossed base plates, which distribute stress evenly, resulting in more holding power; four-way design that places a greater portion of expanding area into undisturbed earth and which also results in more holding power in average soils, the addition of nut retainers which prevents the anchors from sliding up the rod during installation and which also permits salvage of rods in the event of line abandonment or relocation; and exclusive double-strength anchor top which prevents damage from the expanding tool during installation. **Grip-tite Manufacturing Co., CE-11, P. O. Box 111, Winterset, Iowa.**

Prestressed Concrete Standpipe

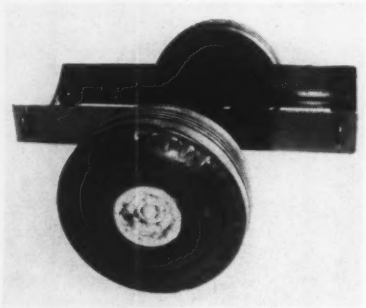
A NEW 2.95 MILLION gallon prestressed concrete standpipe has just been completed as part of a $1,200,000 water expansion program in Sayreville, New Jersey. The largest of its type yet constructed, the cylindrical tank measures 122 ft high by 65 ft inside diameter, the manufacturer states. The tank was built by the slip form method and for the first time forms for the dome were carried up with the wall forms.

The standpipe was prestressed by wrapping the wall and the edge of the dome with high-tensile wire. The wire was stretched or drawn as it was applied by a Preload wire-winding machine suspended along the side of the tank from a carriage which rode the outer edge of the dome. The carriage was anchored to the center of the dome by radial cables and the entire mechanism was self-propelled. **The Preload Co., Inc., CE-11, 211 East 37th St., New York 16, N. Y.**

Pipeline Spans Five Rivers Through New Technique

TWENTY FOUR INCH PIPE for the recently completed Houston Gas Company pipeline from the Rio Grande Valley, Texas to Miami, Florida was carried across five rivers enroute in the form of a suspension bridge, rather than the conventional methods employed in pipeline river crossings.

Key to the successful river crossings, which took only two days apiece, was a new technique of wheeling pipe sections to the river edge on pneumatic tired



New Technique

dollies.

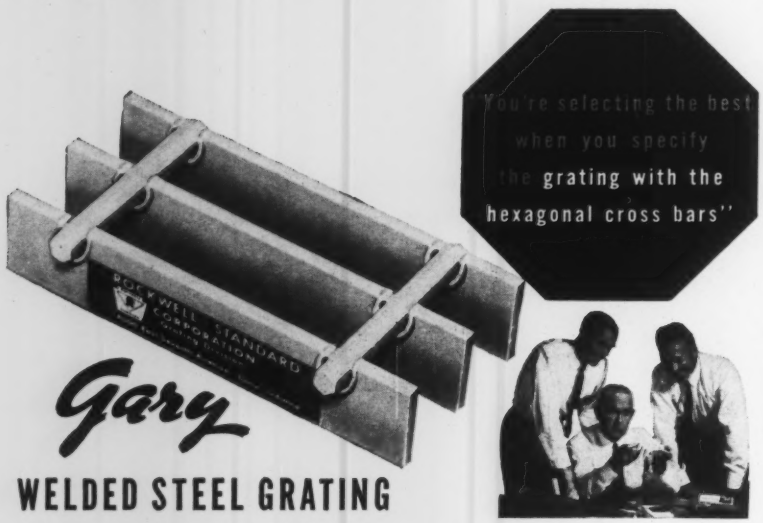
Each pipe section was welded to its full length, up to 900 ft, on the river bank. The pipe span was floated into position beneath the 2½-in. bridge cable by means of a winch on the opposite shore. From there it was drawn up by smaller supporting cables.

The pipe sections, weighing up to 90,000 lb, were maneuvered into position on 10 two-wheeled dollies, which were mounted on 10.00 x 7 flotation tires, manufactured by the Harmo Tire & Rubber Corp. **Modern Hydraulics, Inc., CE-11, 130 Grand Lake Blvd., West Chicago, Ill.**

Hi-Speed Printmaking

THE DEVELOPMENT OF a new, high-speed Diazo blue has been announced. Now in a matter of seconds, directly from translucent originals, strong blue line reproductions can be printed. Developed dry with aqua-ammonia vapor, these easy to read prints are ready for use.

Super-fast "Driprint" Blue has amazing density and good contrast giving excellent prints from pencil tracings and poor originals; it is ideal on low powered light source machines for all types of reproductions and on high speed machines from poor or soiled originals. **Eugene Dietzgen Co., CE-11, 2425 N. Sheffield Ave., Chicago 14, Ill.**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Gary
WELDED STEEL GRATING

Cross bars pressure welded to main bars, can't come loose.

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Available in Standard Mesh, Close Mesh and Sidewalk Mesh. Also in stainless. Catalog 14-R gives complete engineering data.

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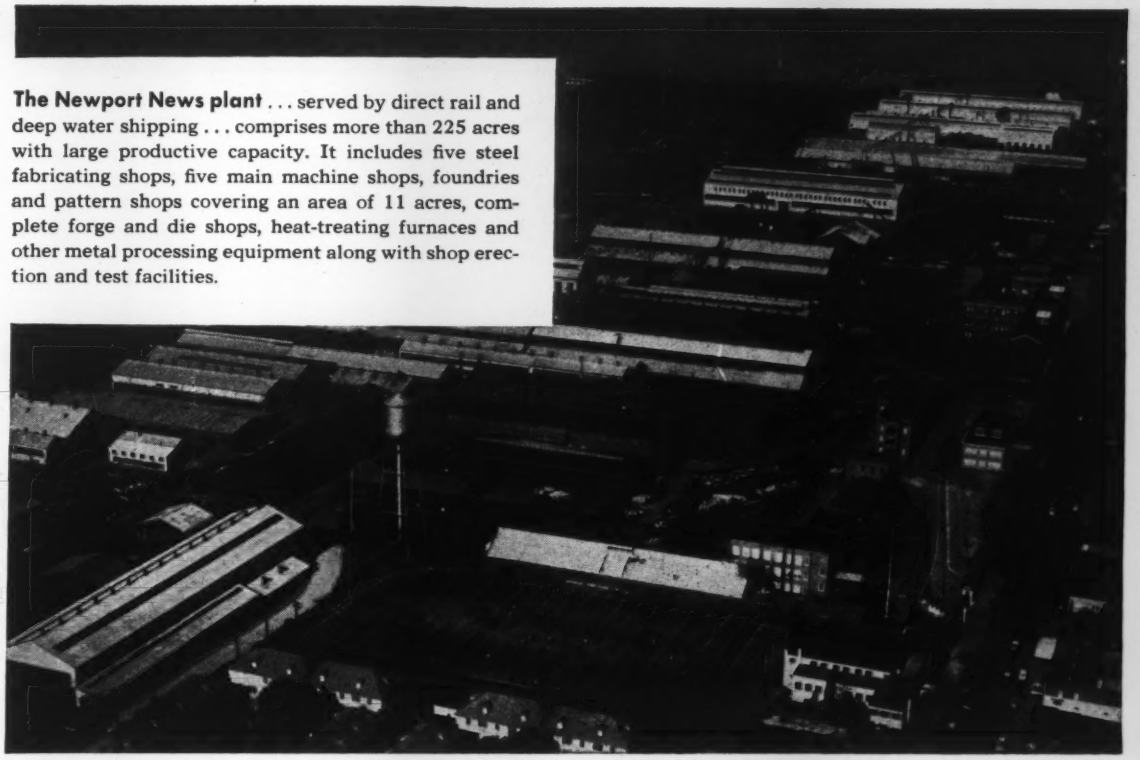
The Newport News plant . . . served by direct rail and deep water shipping . . . comprises more than 225 acres with large productive capacity. It includes five steel fabricating shops, five main machine shops, foundries and pattern shops covering an area of 11 acres, complete forge and die shops, heat-treating furnaces and other metal processing equipment along with shop erection and test facilities.



Make Newport News your source for fabricated metal structures

Let Newport News fabricate your weldments or sub-assemblies. Call on us for plate fabrication . . . from vacuum tanks to bridge caissons . . . for pumps, valves, pipe lines . . . you'll find that Newport News fabricates parts to answer most demands.

In the vast plant, shown above, Newport News craftsmen complete your orders with specialized production techniques, and with sound experience acquired through construction of thousands of products ranging from small components on rayon spinning machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee.

See for yourself what Newport News is doing, and how this company's high integration of skill and production facilities can help you. Get the facts, shown in *Facilities and Products.* A copy of this illustrated booklet is yours for the asking . . . write for it now.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

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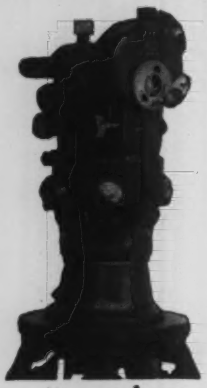

and There's a KERN REPRESENTATIVE in Your Area... *to Serve* YOU!

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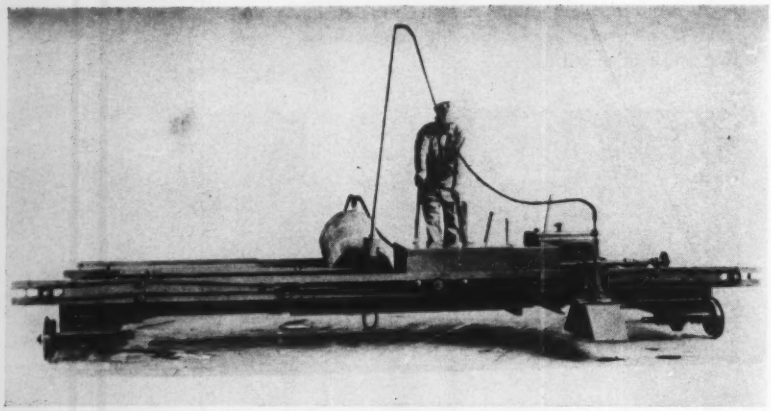
EQUIPMENT, MATERIALS and METHODS

(continued)

Automatic Spray Curing Machine



CONTRACTORS WILL APPRECIATE THE new Flex-Plane Automatic Spray Curing machine which features a better, faster, more economical method of membrane type curing for highway slabs.

An improved double spray head, coupled with a high efficiency pump, insures double coverage with economy of material. Only a small portion of pump output is used at the spray nozzles. Excess material is pumped back into the drum eliminating waste and preventing material in the drum from separating and settling. A fluid regulator maintains a constant spray pattern. It can be easily adjusted to suit. Rate of the machine's travel can be set to any desired speed assuring its keeping pace with the rest of the paving train.

The Flex-Plane Curing machine can be used with a single operator, or preset for unattended operation. Burlap drag, brooming or belting attachments can be supplied as optional equipment. **Heltzel Steel Form & Iron Co., CE-11, Warren, Ohio.**

"Do-It-Yourself" Blueprinting

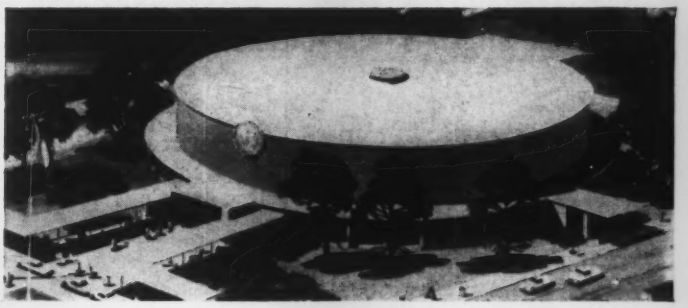
SINCE THERE IS NO standard form for reporting results of soil surveys or foundation borings, a complete and comprehensive presentation of the data developed by field crews is usually worked up for each job. The traditional next stop is to send drawings to a commercial blueprinter—often miles away—and wait for them to come back. A new budget-priced diazo printer which makes crisp blue-line white-prints of anything printed, typed, written or drawn on any translucent original eliminates this bottleneck.

Since the Blu-Ray machine is exceptionally easy to operate, field men accustomed to waiting for check prints to be returned, now make their own in minutes. Procedures for field work, previously typed with a limited number of carbons, are now available in any desired number. On rush jobs no time is wasted looking for misplaced copies. The original can be taken from the files and duplicated in a few minutes.

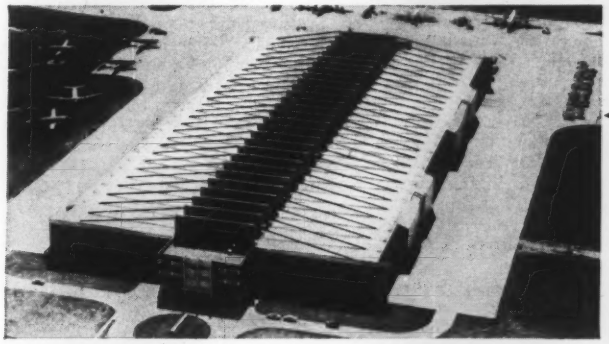
The Blu-Ray makes prints the equal of any large machine, the manufacturer states. Speeds up to 4 ft a minute take care of rush jobs. Blue and black line paper at pennies per square foot are about 1/5 what one would pay for outside work. No limitations so far as size of work have been found; 42-in. prints are handled with surprising ease and 4 or 5 regular letter size prints can be run through at once. **Reproduction Engineering Corp., CE-11, 416 North Main St., Essex, Conn.**

Chamfer Strip

A NEW INNOVATION in chamfer strip for use on all types of concrete forming has been developed. This chamfer strip has a special rubber extrusion of the proper consistency and stiffness to provide complete flexibility and reusability. Use of this strip will provide contractors with the lowest possible cost as well as eliminate the very serious problem of grout leekage at chamfer corners. **Universal Form Clamp Co., CE-11, 1238 N. Kostner Ave., Chicago 51, Ill.**

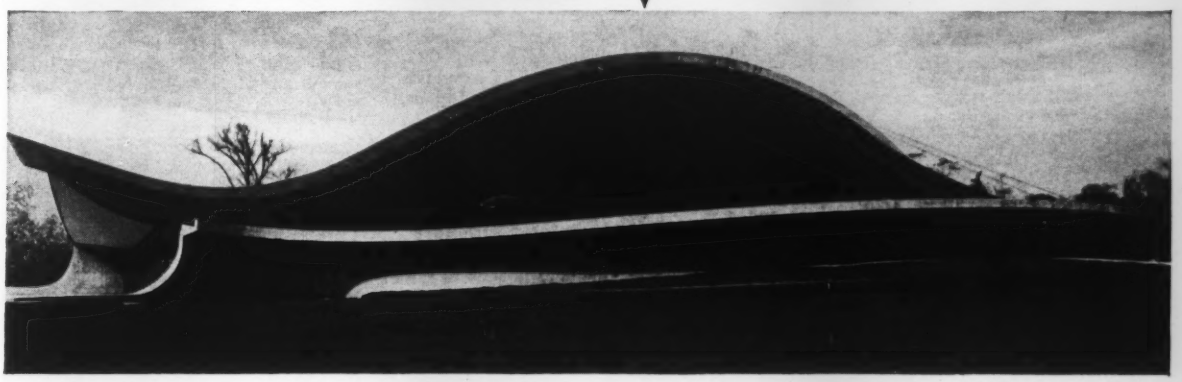


UTICA MEMORIAL AUDITORIUM, N. Y. *Architects:* Gehron & Seltzer, New York City • *Associate Architect:* Frank C. Delle Cese, Utica • *Consulting Engineer:* Dr. Lev Zetlin, New York City • *Contractor:* Sovereign Construction Company, Ltd., Fort Lee, N. J. • *Roof Supporting Structure, Including Cables, Furnished and Erected by Roebling*



TWA HANGAR – MID-CONTINENT INTERNATIONAL AIRPORT, KANSAS CITY • *Designed by* Burns & McDonnell, Kansas City • Ammann & Whitney, *Consulting Engineers,* New York City *Contractors:* MacDonald-Creighton, St. Louis and Nashville • *Cables by Roebling*

YALE UNIVERSITY'S – DAVID S. INGALLS ICE HOCKEY RINK, NEW HAVEN • *Architect:* Eero Saarinen and Associates, Bloomfield Hills, Michigan *Consulting Engineers:* Severud-Elstad-Krueger, New York City • *Contractor:* George B. H. Macomber, Boston and New Haven • *Cables by Roebling*



Hockey, Planes, Buses and Inventories . . . the suspended roof covers them all with unobstructed beauty

The suspended roof beautifully weds aesthetics and practicality. This daring and down-to-earth design and construction technique has literally "spread its wings" over a number of different structures to the dollars and cents benefit of its builders as well as to the delight of its observers.

Terminals, sports arenas and warehouses are currently enjoying the *unimpeded* scope of movement and view afforded by the roof that needs no columns. Material, man and events *move* under the suspended roof with an ease heretofore unknown. Trucks can turn, planes can be serviced and "every seat in the house" is a vantage point under the suspended roof.

Shown here are a few of the examples of what architects and builders are doing with the suspended roof. We at Roebling seriously invite your inquiries on *any* phase of the suspended roof or other types of suspension systems. Our history includes suspension bridges of every description, tramways, guyed towers and ski lifts. Any means of communication to John A. Roebling's Sons, Bridge Division, Trenton 2, New Jersey, will bring you a wealth of material.

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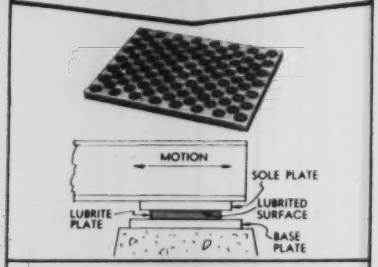

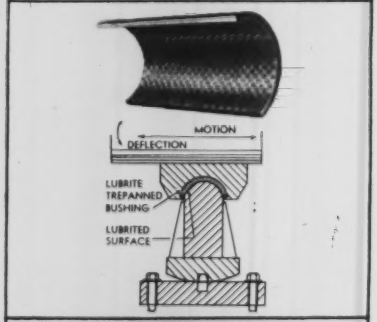

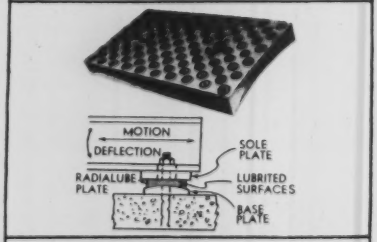

When expansion, contraction and/or rotation of structural members are factors in the design of any bridge, overpass, building or other construction, Lubrite offers many distinct and important advantages. Specifically Lubrite permits the use of simplified designs, cuts construction costs substantially, virtually eliminates maintenance and offers a low coefficient of friction. Assure better results, longer life and unequalled performance — specify Lubrite — over 50 years of success "where others have failed"

Send for this free 20 page Lubrite Manual No. 55 — contains complete information, technical data and specifications about Lubrite Self Lubricating Plates and Bushings.

LUBRITE DIVISION
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EQUIPMENT, MATERIALS and METHODS

(continued)

"Fireproofed" Wood Building

A NEW STANDARD of industrial construction, the Cross, Austin "Fireproofed" Wood Building, has been unveiled to the building trades.

The unque wood-and-aluminum structure, use of which was made possible here by recent New York City building code revisions, is expected to be fully competitive with conventional buildings for such uses as factories, warehouses, garages and bowling alleys. The revised code permits use of such fireproofed wood for structural members in Class 5 buildings, which are one-story structures with a maximum of 15,000 sq ft of floor space.

The new building also features an exterior of ribbed aluminum siding and corrugated aluminum roofing supplied by Aluminum Company of America; the street side is finished in Alcoa's spruce green Alumalure siding.

An advantage of the fireproofed wood construction is that practically no maintenance is required. In addition, aluminum is easy to apply, affords high reflectivity of light and heat, and is available in several colored or natural finishes. Also the new building is cheaper than conventional buildings and its insurance rate is lower. **Cross, Austin & Ireland Lumber Co., CE-11, 1246 Grand St., Brooklyn 11, New York.**

Safety Device Protects Offshore Drilling Platforms

A SIMPLE BUT INGENIOUS safety device has been developed by a Texas firm to provide night-and-day protection to the mammoth offshore drilling platforms it manufactures.

This latest innovation consists of a self-leveling mechanism to control each leg individually. If faulty ocean bottom causes the platform to tilt, the self-leveling system snaps into action automatically so that the platform can be brought into perfect horizontal position again. It will protect any electrically-powered platform before developing a serious list which could possibly result in catastrophic consequences and it will permit continual stability. **R. G. LeTourneau, Inc., CE-11, 2399 South MacArthur, Longview, Texas.**

Vocameter

PREVIOUSLY HARD-TO-SOLVE problems of safety, physical obstructions, inconvenience and human concentration find solution with the unique new "talking meter," a digital instrument with a new dimension in "readout."

Easily adaptable to the computers of other manufacturers, the Vocameter is designed primarily to provide a verbal "readout" and its input can be widely varied. Any voltage-producent computer within the proper range level, for example, can activate the instrument.

New conveniences in factory and laboratory measurement work can be added by a "readout" dimension which increases sensory impression with readings in sight and sound and also can increase the size of working audience cognizant of a measurement. Further application can be found where information is required, as in a check-out system, on a continuous basis but where the information needs to be supplied without the requirement of high human concentration. **Cubic Corp., Industrial Div., CE-11, 5575 Kearny Villa Road, San Diego 11, Calif.**

Solaroof

CONSTRUCTED OF HEAVY DUTY aluminum extrusions and several layers of tough and durable plastic such as that used in aircraft components, the Solaroof is specifically designed for Esther Williams "Supreme" and "Living" pools, but will also convert any other pool into a year 'round recreation center.

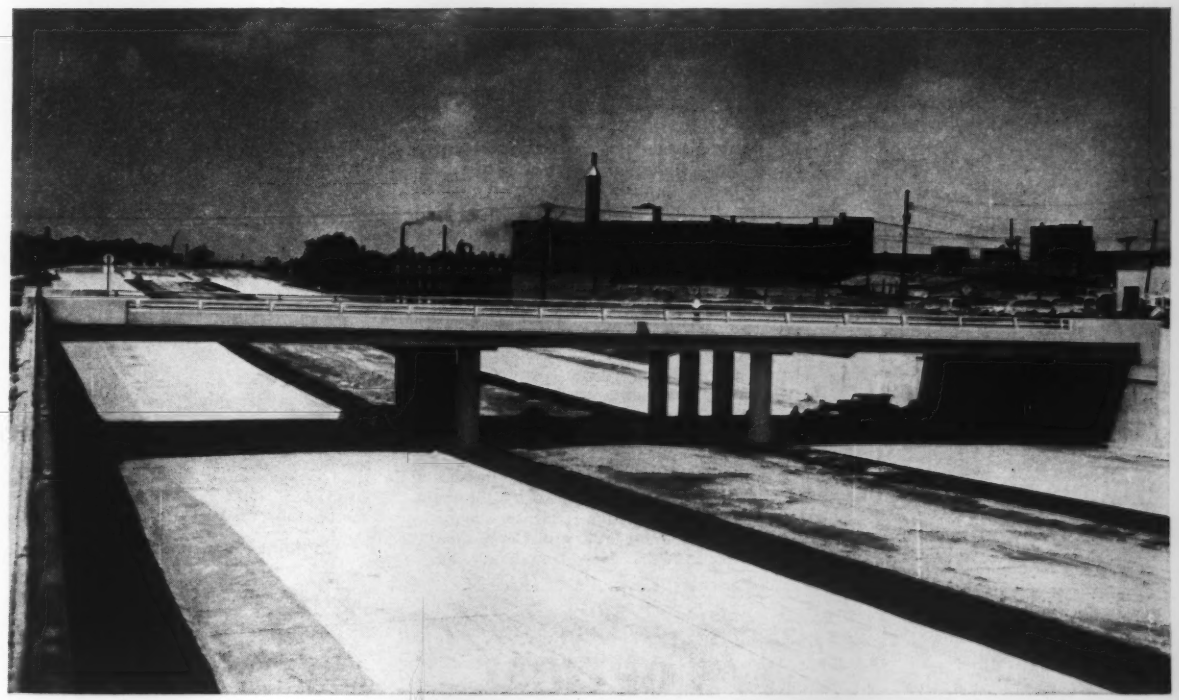
Thoroughly tested under heavy snow conditions, the Solaroof has performed excellently under snow loads and extreme temperatures. Through the use of brand new radiant heating devices, and a standard pool water heater, swimming is now

Year 'Round Recreation Center

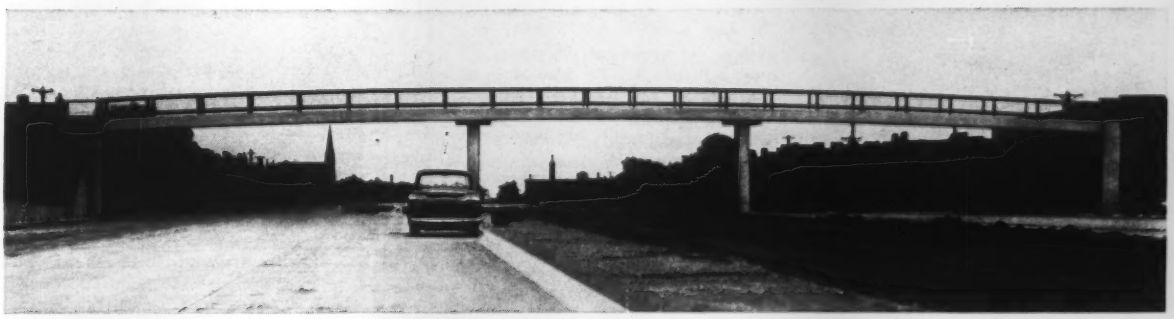
as practical in mid-January as it is in mid-August. The special translucent plastic, while affording a maximum of privacy, allows the beneficial rays of the sun to enter the enclosed pool area even on dull winter days.

Solaroof will require from two to four days for installation on an Esther Williams pool, including not only the roof itself, but weatherproofed sides and doors. With the advent of warm weather, the pool owner removes a few panels from the roof area, and his pool is now ready for summer use. **International Swimming Pool Corp., CE-11, 188 East Post Road, White Plains, New York.**

Modern Simplicity in Reinforced CONCRETE



Continuous reinforced concrete void slab
St. Louis Avenue Underpass, Mark Twain Expressway, St. Louis, Missouri
Project I-70-5 (23) 242
Contractor: Fred Weber Contractor, Inc.



Reinforced concrete pedestrian crosswalk.

Throughout the vast network of new expressway systems under construction, highway engineers are utilizing reinforced concrete to enhance roadway areas with structures of modern simplicity. Whether you are designing an underpass, bridge, or a complex traffic interchange, you will find reinforced concrete the logical, economical solution. It is lower in first cost, requires less maintenance, and its unusual flexibility offers greater design freedom. In addition, all necessary materials and labor are readily available. Your project starts on time—finishes on schedule.

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(continued)

Diesel Pile Hammer

THE INCLUSION OF A diesel pile hammer in its line of pile driving equipment was announced by the company in 1956. Today these hammers, two models and third soon to be announced, comprise a substantial part of the company's pile hammer sales. Records show that the majority of hammers (approximately 85% including railroad owners) are used primarily in bridge construction; they have proved to be especially suitable for concrete piles because of their preloading effect. They have also been used to economic advantage on wood, H-Beam, steel sheet and light and heavy wall pipe or tubes. In addition they have been successfully used for both pavement and rock breaking. The special spring loaded anvil permits this type use without causing damage to the base of the hammer. **McKiernan-Terry Corp., CE-11, 100 Richards Ave., Harrison, New Jersey.**

New Type Holepuncher

A NEW "SLIDING WEIGHT" holepuncher (patent applied for) which successfully installs wellpoints in hard-to-penetrate soils where it has proved difficult or impossible to jet the wellpoints into the ground, or to install with standard type holepunchers, has been announced.

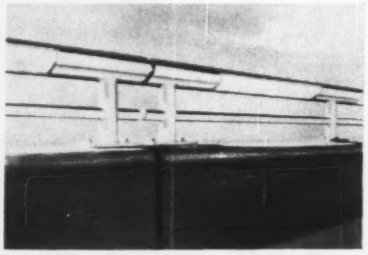
Bouldery soils, soils intercalated with layers of hardpan, dolomitic limestone or cemented gravel, when ground water is encountered in these and similar soils contractors have hitherto been wary of attempting wellpoint pre-drainage because of the installation problem. This same problem also mitigates against the use of the alternative, if costlier, method of driving a steel sheet pile cofferdam in such soils. The new "sliding weight" holepuncher successfully copes with these conditions and thus broadens the field of wellpoint application.

By means of a crane-controlled cable, the holepuncher is positioned upright, with its cutting head resting on the ground, and thereafter driven or allowed to sink a foot or so below grade. Jetting water is then pumped through the shank. The holepuncher is driven into the ground by alternately raising the sliding weight (which is controlled by the crane operator) and letting it fall on the striking plate. **Griffin Wellpoint Corp., CE-11, 881 E. 141st St., New York 54, N. Y.**

New Highway Railing

A UNIQUE NEW TYPE of aluminum highway railing that contains General Electric fluorescent luminaires for roadway lighting is available.

Called Lupton Railight, it offers three advantages when compared with conventional highway road railing and lamp post construction. They are: greater driver safety from uniform low-level light focused directly on the road; unlimited possibilities for individualized road railing design; and savings in initial cost, operation and maintenance.



Contains fluorescent Luminaires

In construction, Lupton Railight consists of a 6- or 12-ft long rail that is shaped like a beveled triangle. Openings approximately 3-in. wide by 42-in. long are spaced at 2-ft intervals to permit the installation of special fluorescent luminaires. A rigid shield of clear plastic covers the opening to protect the luminaire. Other features of this top rail include a cable raceway, reinforcing spine, drain holes to eliminate condensed moisture, and a top cover held in place by screws that can be easily removed for ground level maintenance. **Michael Flynn Mfg. Co., CE-11, 700 East Godfrey Ave., Philadelphia 24, Pa.**

Bit Grinder

A SELF-CONTAINED UNIT designed for grinding large bits with controlled grinding-wheel movement to finish all surfaces accurately has been introduced.

The company says the G6 Bit Grinder is designed basically to sharpen the larger detachable bits with G-D 600, 700 and 1000 series threads and "Mole-Dril" bits. But it also may be used for small sizes such as Timken A, D and K. The machine grinds either "Cross" or "X" bits easily with a fast, simple interchange to fixture for gauge grinding.

The G6 aligns itself as the detent pin locks in place for each grinding operation of the bit face. Precision grinding is insured by fixture positioning of the bit to give a perfect renewal of cutting surfaces and gauge. **Gardner-Denver Co., 100 Williamson St., Quincy, Ill.**

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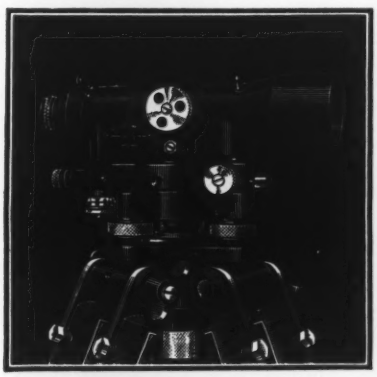

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DIETZGEN

EQUIPMENT MATERIALS and METHODS

(continued)

New Floodlights

THE NEW LINE of outdoor Power Beam floodlights is complete with an ingenious spring construction (patent pending) that cuts relamping time in half. With no tools or prying devices required, lamp replacement is not only faster but easier and safer. At a touch, a heavy-duty steel coil automatically "pops" the old lamp out. New lamps "snap" into place instantly. Once secured, the lamp "floats" in a coil-spring cradle that practically eliminates many common causes of premature lamp failure, such as excessive vibration caused by rumbling traffic, shock or pole-whip.

The new construction is designed to save maintenance personnel time and labor, while reducing the hazards of bulb changing when floodlight clusters are high-mounted or hard-to-get-at, as in industrial or recreation areas, ball fields, service stations, parking lots, piers, display or architectural facade lighting. **Stonco Electric Products Co., CE-11, 333 Monroe Ave., Kenilworth, New Jersey.**

Process Establishes Soil Stabilization

A PROCESS INVOLVING the use of a specially prepared wood pulp to quickly establish a permanent sod on embankments and levees has been announced.

The process consists of mixing the special wood pulp, grass seed, and fertilizer in the proper proportions into a water slurry and applying it evenly over the slopes with a high-speed air blast. The mixture dries quickly to form a papier-mache-like blanket, which encourages seed germination and protects the slopes from erosion.

Equipment employed by the process was developed jointly by International Paper Co. and the John Bean Division of the Food Machinery and Chemical Corp. and includes a 1500-gal slurry tank, a pumping unit, and a modified Rotomist blower. The pumping unit is capable of delivering 150 gal of slurry per minute to the sprayer which has an effective range in quiet air of about 125 ft.

Once the slurry tank is properly charged, only a sprayer operator and a truck driver are needed to operate the equipment. Communications between the two is by battery-powered telephone. The operator controls the direction and tilt of the sprayer to apply the slurry in a sweeping motion as the truck moves forward. Under the direction of a foreman, the average crew can spray-plant 6.3 acres of surface in an eight-hour day. **International Paper Co., Southern Kraft Div., CE-11, Mobile 9, Alabama.**

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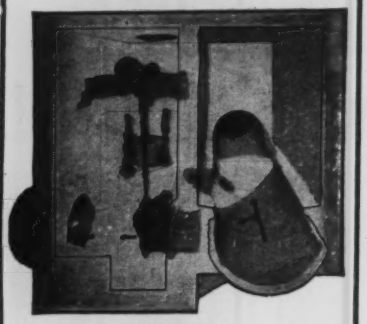

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

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EQUIPMENT, MATERIALS and METHODS

(continued)

Jet Blast Deflection Fence

A NEW "JET BLAST deflection fence" made of ten-foot-high concrete slabs serves to protect a nearby parking lot and auto driveway from the blasts of flame, smoke, and rushing air given out by TWA's giant Boeing 707 jet transports. The 536-ft fence is made up of sixty-seven 3-in. concrete slabs, each 8-ft long and 10-ft high, and supported by concrete "A-frames." As the planes run up their jet engines the concrete-slab surface takes the jet blast and deflects it sharply upward.

By conventional slab-making methods, the sixty-seven segments of the deflection fence would have been poured individually on the ground. In pouring the slabs atop one another, in groups of ten, the contractor stacked them like "pancakes." As each slab was poured, its upper surface was used as the "floor" to form another slab on top of it. Wood sides for each succeeding slab were placed in position as time for the pouring came around.

Deflects Jet Blast

The new slab-upon-slab pouring technique was made possible by spraying Horn Parting Compound on top of fresh-poured slabs just before laying down the next succeeding slab, thus preventing adhesion of one slab to another. The compound not only inhibited the bond between slabs but served as a curing compound to insure the proper hydration of the concrete. **Sun Chemical Corp., CE-11, 750 Third Ave., New York, N. Y.**

Hydraulically-Snubbed Chain System

CENTRIFUGAL PUMPS WEIGHING less than 4000 lb maintain the hydraulic pressure which enables chain barriers to stop huge ships before they can reach lock gates. The Panama Canal Company has recently installed 36 of the 100-hp pumps.

The 15-ton chains are stretched across the locks in case the Canal's famous "mechanical mules" should lose their towlines to a ship. If the mules can't stop a ship after it has moved into a lock, the ship will strike a chain across the lock and be snubbed to a stop. The chains are connected to a hydraulic system which maintains a constant tension of 100 tons on the chains, a tension which slowly but surely brings the ship to a stop short of the gates. The slow steady snubbing action prevents the chains being strained beyond their breaking point, and avoids damage to the ship's bow.

The 100-ton tension enables a ship of 5000 gross displacement tons, moving at 5.5 knots, to be stopped within 70 ft. A 10,000-ton ship moving at 3.8 knots, or a 60,000-ton ship moving at 1.2 knots, can be stopped in the same distance. To maintain the pressure, the pumps are each capable of delivering 555 gal per minute against a pressure of 150 psi. **De Laval Steam Turbine Co., CE-11, Trenton 2, New Jersey.**

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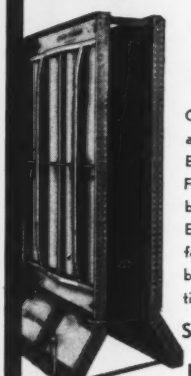

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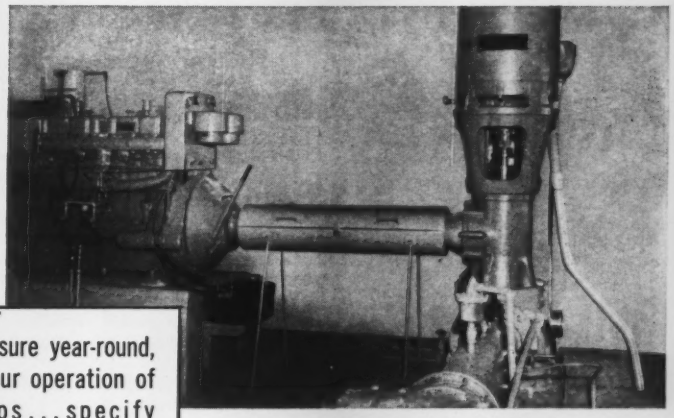
Literature Available

VANE SHEAR TESTING—Bulletin 700-R describes the Vane Shear Test method of in-place soil testing. Sixteen drawings and photographs clearly illustrate the procedures and the tools necessary for vane shear testing. Two complete kits for vane shear testing are offered by the company. Engineers, construction men and others responsible for gathering soils information preparatory to foundation construction and road building will appreciate the fast, accurate data that can be inexpensively obtained through in-place shear tests. **Acker Drill Co., Inc., CE-11, Box 830, Scranton 2, Pa.**

HEAVY DUTY ELECTRIC HOISTS—A complete selection guide for heavy duty electric hoists ranging from ¼-ton to 12-ton capacity is presented in a new 34-page catalog. Factors covered by the guide include capacity of hoist speed and height of lift, dimension of seam, type of hoist suspension, controls, current supply and operating conditions. The bulletin also contains dimensional drawings and detailed specifications for the company's line of Lo-Hed electric hoists, which are available for use on job cranes, gantry cranes, single and double girder bridge cranes, as well as special monorail track or standard I-beam. **American Engineering Co., CE-11, Wheatsheaf Lane and Sepviva St., Philadelphia 37, Pa.**

FIRE PROTECTING STEEL—Titled "Fire-Resistant Construction in Modern Steel-Framed Buildings", this 44-page booklet presents for easy reference the significant features of the fire-protective materials and fire-resistant systems that make steel-framed buildings economically competitive as well as structurally fire-safe. Included are sections on modern building codes with reference to general acceptance of performance tests; the characteristics of safe, dependable fireproofing materials; the concept of "light-frame" fire resistant steel construction; and a reference table showing more than 150 fire-resistant constructions and their fire-resistant ratings. **American Institute of Steel Construction, CE-11, 101 Park Ave., New York 17, N. Y.**

AIR ENTRAINMENT METER—A new 6-page bulletin which describes a precision type of air entrainment meter to be used in testing and designing concrete mixes has been made available. It contains complete operating instructions and illustrations on the meter to enable the operator to obtain precise determinations of the air entrained in concrete. The meter simplifies the application of Boyles Law for entrained air determinations. The readings are made direct and the entire test can be conducted quickly and easily by an engineer or technician. **Soiltest, Inc., CE-11, 4711 W. North Ave., Chicago 39, Ill.**



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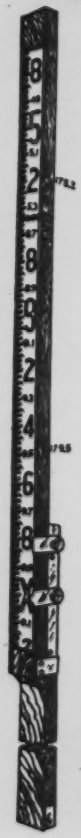
Literature Available

MEN, METHODS & MACHINERY—Engineers, architects, public officials, industrial builders—anyone concerned with mechanics, earthmoving, land reclamation and general construction will find information of unusual interest in "Men, Methods & Machinery". This 52-page brochure describes a number of engineering "firsts", including many pictorial case histories showing methods of operation and equipment used on some of the most challenging and unusual projects of their kind ever undertaken. From Chicago's shoreline to the Surinam River—from Israel's papyrus-clogged Lake Huleh to frozen Canadian lakes, the booklet tells how the company has devised practical cost-cutting solutions to extremely difficult engineering problems. **Construction Aggregates Corp., Dept. CV-9, CE-11, 120 S. LaSalle St., Chicago 3, Ill.**

PLACING REINFORCING BARS—This manual summarizes the best of the accepted current practices in the placement of reinforcing bars, welded wire fabric and their supports in reinforced concrete structures. The book will be most helpful to field engineers as it gives in simple language with excellent illustrations details of how steel should be placed, supported and tied. Permissible tolerances are given with reasons for accuracy so that the importance can be explained to the field forces. A glossary of terms and simple sketches showing names of various components of construction will help those new to field work to an immediate understanding of construction job jargon. The handbook is available at $3. **Concrete Reinforcing Steel Institute, CE-11, 38 South Dearborn St., Chicago 3, Ill.**

ONE-CELL PRESSURE FILTERS—An 8-page booklet on the installation and operation of modern one-cell pressure filters, covering both above-ground and below-ground models of from 18 in. to 42 in. diameter, has been published. Profusely diagramed and chartered, the manual has been written and prepared with the inexperienced residential pool owner in mind. There is a complete section on Operation Procedure plus instructions on how to get maximum efficiency from your filter as well as tips on trouble-shooting. **Modern Swimming Pool Company, Inc., CE-11, One Holland Ave., White Plains, New York.**

EXPANSION JOINT LITERATURE—A compact, 6-page bulletin on S-R Expansion Joints is now available. The photographically and graphically illustrated brochure contains general information on flanges, liners, covers, temperature ratings and other material of interest to joint users. A list of the company's representatives also is included. **Expansion Joint Division of Badger Manufacturing Co., CE-11, 230 Bent St., Cambridge 41, Mass.**



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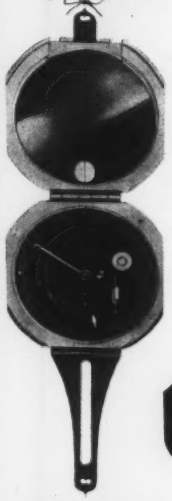

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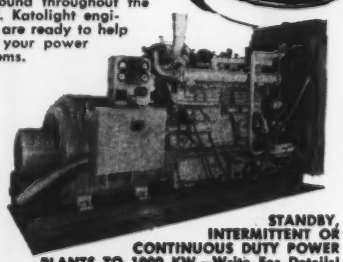

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From the MANUFACTURERS

RECEIVES AWARD: The military's Joint Chiefs of Staff has selected Robert G. LeTourneau to receive the 1959 National Defence Transportation Association's Award. It identifies Mr. LeTourneau as the person "whose achievement contributed most to the effectiveness of the transportation industry in support of national security." . . . **PUBLIC RELATIONS PROGRAM:** A new Public Relations program has been undertaken by the Water and Sewage Manufacturers Association. All mass media will be used to alert the public to the necessity of expanding water and sewage facilities to meet requirements of our expanding population . . . **NEW ACQUISITIONS:** Acquisition of the Flofilm Div. of Diebold, Inc. was announced by Photostat Corp. Flofilm manufactures and markets a line of microfilm cameras, readers, processors and related supplies and equipment. Photostat, a subsidiary of Itek Corp., manufactures and distributes microfilming, photocopying, office copying and offset duplicating equipment and supplies . . . All quarries and stone crushing facilities of Perry Jones, Carbondale, Kansas have been purchased by American-Marietta Co., producer of construction and building materials . . . **DISTRIBUTORS APPOINTED:** Midwest Piping Co., Inc., St. Louis, has announced the appointment of Oil Well Supply Div., United States Steel Corp., as distributor for the Midwest line of welding fittings and flanges for petroleum pipelines and refinery piping systems . . . Wright-Thomas Equipment Co., Charleston, W. Va., has been appointed crane-excavator distributor by Bucyrus-Erie Co., South Milwaukee, Wis. . . . **EXPANSION PROGRAM:** A major expansion program now under way will double production at the St. Louis, Mo. plant of the W. S. Dickey Clay Mfg. Co. It has been undertaken to keep pace with the growing demand for clay products in the booming Missouri and Illinois markets . . . The construction of six new, 40-ft periodic kilns is spearheading a $750,000 expansion program at the Robinson Clay Product Company's Factory 8 in Pottstown, Pa. . . . **NEW COMPANY FORMED:** Chicago Bridge & Iron Co., Chicago, has announced formation of a company in The Netherlands to erect large steel plate structures fabricated in that country . . . **HEADQUARTERS MOVED:** Ramset Fastening System has moved its headquarters from Cleveland to New Haven, Conn. Ramset is part of the Winchester-Western Div. of Olin Mathieson Chemical Corp., which has headquarters in New Haven . . . **NEW PLANT:** Construction of a multi-million dollar tire manufacturing plant by Firestone Tire & Rubber Co. of Canada, Ltd., has started on a 50-acre site in Calgary, Alberta . . . **MERGER:** Effective January 1, 1960, two of the oldest and best-known names in the field of water measuring equipment will join forces. Negotiations leading to the merger of Hersey Manufacturing Co., Dedham, Mass., and Sparling Meter Co., El Monte, Calif., have been completed, subject to approval by stockholders of both firms . . . **ENGINEERING CONSULTING GROUP:** Recognizing the need for a specialized consulting service in the fast-growing prestressed concrete field, Rockwin Prestressed Concrete Corp., Santa Fe Springs, Calif., has announced the formation of such an engineering consulting group under the name "Rockwin Engineers" . . . **NEW SERVICE:** A valuable new service especially suited to individuals or firms contemplating going into or expanding current prestressed concrete operations has been developed by Leap Associates. The company offers a two-day analysis and feasibility conference at its Lakeland headquarters in which information supplied by a firm planning entry into or expansion in the prestressed industry is analyzed to determine if such a plan of operation is feasible . . . **APPOINTMENTS:** Apointment of H. S. Allen to the post of Vice President, has been announced by Hamilton Kent Manufacturing Co., Kent, Ohio, makers of flexible sewer pipe couplings and acid-resistant pipe coating . . . Henry Swigert is the new district sales representative in Arizona and New Mexico for Electric Steel Foundry Co. From his headquarters in Phoenix, he will handle sales of Esco alloy and stainless steel products for the construction, mining and process industries.

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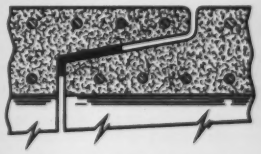

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Journals: Air Transport, Engineering Mechanics, Hydraulics, Pipelines, Power, Soil Mechanics and Foundations, Structural.

2189. Longitudinal Distribution of Wheel Loads on a Runway, by R. W. Smith and R. Horonjeff. (AT) This paper examines existing runways in the light of the jet age, and analyzes the economy factors in runway construction.

2190. Civil Engineering Features of the Los Angeles International Airport Development, by Frank A. Grainger. (AT) This paper reviews the history and development of the Los Angeles International Airport. Among the topics touched upon are aircraft ground traffic flow, design stresses for jet airliners and aircraft fueling systems.

2191. Architectural Planning and Treatment of Airport Problems, by Donald E. Wilcox. (AT) The paper deals with the project development associated with the airfield improvements and new terminal facilities at Los Angeles International Airport over a period of years, citing some of the planning, design and coordination problems.

2192. Construction of a Prestressed Concrete Test Pavement, by Carl F. Renz. (AT) The construction of a full scale prestressed concrete pavement which is to be subjected to controlled traffic testing is described.

2193. Jet Airport Lighting Requirements, by M. A. Warskow. (AT) Future airport lighting fixtures will frequently be installed in heavy-duty paved surfaces and thus provision for them must be included in early phases of planning. Aids for approach, landing and ground traffic control are examined.

2194. Elastic Bending of Layered Plates, by K. S. Pister and S. B. Dong. (EM) A system of equations governing the non-linear bending of plates consisting of two or more bonded, thin layers is presented.

2195. Flexible Surfaces on Viscoelastic Subgrades, by B. C. Hoskin and E. H. Lee. (EM) This report is concerned with the analysis of stress and deformation of a subgrade strengthened by a flexible surface plate subjected to a load distribution.

2196. Solutions for One-Dimensional Structural Lattices, by Donald L. Dean, Jr. and Selmo Tauber. (EM) A brief argument is presented on the advantages of using closed form solutions to difference equations as a tool for structural analysis.

2197 Electrical Analog for Earthquake Yield Spectra, by G. N. Bycroft, M. J. Murphy and K. J. Brown. (EM) An electrical analog has been designed to simulate a damped single degree of freedom, elasto-plastic structure subjected to an earthquake.

2198. The Neutral Axis in Plastic Bending of Beams, by Aris Phillips. (EM) The motion of the neutral axis in symmetrical pure bending of beams in plasticity is examined.

2199. Laterally Loaded Thin Flat Plates, by William A. Bradley. (EM) Certain laterally loaded thin plates were studied experimentally, using the Moire method, and analytically, by finite differences. The procedures followed in this study are summarized.

2200. The Hydraulic Design of Slotted Spillway Buckets, by G. L. Beichley and A. J. Peterka. (HY) A slotted roller bucket for use as a submerged energy dissipator at the base of an overfall is developed from hydraulic model tests and is compared with a solid-type bucket.

2201. Performance of Flood Prevention Works During the 1957 Floods, by Charlie M. Moore. (HY) The hydrologic and structural performance of watershed protection and flood prevention works of the Soil Conservation Service in Arkansas, Oklahoma and Texas during the severe storms and floods of April, May and June, 1957 is reviewed in this paper.

2202. Wave-Induced Motion of Bottom Sediment Particles, by P. S. Eagleson and R. G. Dean. (HY) Theoretical analyses are presented yielding expressions for incipient motion and net velocity of single spherical bottom sediment particles under oscillatory waves.

2203. Dewatering Pipeline Coal Slurry, by Clarence A. Dauber and Neal F. Gill. (PL) This paper describes the design of the dewatering and drying facilities for the first successful long distance coal slurry pipe line transportation system.

2204. Regulation of Pipeline Design and Construction. (PL) Development of Canadian oil and gas has resulted in regulation of pipeline design and construction by the provinces of Alberta, British Columbia, Manitoba and Saskatchewan. These regulations are here compiled and abstracted.

2205. Bibliography on Pipeline Design, Construction and Operation: Progress Report of the Task Committee on Compilation of Bibliography of Reference Materials on Pipeline Design and Construction of the Committee on Pipeline Design, Specifications and Operating Standards of the Pipeline Division. (PL) The Pipeline Division, through a Task Committee, has released a Compilation of Bibliography of Reference Materials on Pipeline Design and Construction.

2206. Control of Cracking in Concrete Gravity Dams, by William R. Waugh and James A. Rhodes. (PO) This paper traces the evolution of crack control measures and describes current Corps of Engineers practices and results.

2207. Field Study of Interior Temperatures in Concrete, by D. L. Houghton. (PO) Interior temperatures attained by concrete in a thin arch and gravity dam are reported.

2208. Raising Transmission Towers with Energized Lines, by A. G. Masters and E. J. Gesing. (PO) To build additional lines and to reconductor existing lines with larger wires, towers on existing lines are increased in height by adding an extension to the bottom.

2209. Addition to Generating Capacity At Wilson Dam, by Robert A. Monroe. (PO) This paper outlines the planning and design of Wilson Dam and power plant and examines the major problems of construction for a 3-unitpower plant extension of 162,000-kw capacity to be completed in 1961.

2210. A Statistical Study of Soil Sampling, by Thomas H. Thornburn and Wesley R. Larsen. (SM) This is a study undertaken to determine the number of samples needed to obtain reasonable correlations between pedologic soil types and their engineering properties.

2211. Construction Materials Control—AASHO Road Test, by James F. Shook (SM) A brief description of some of the test methods and statistical quality control procedures used during construction of the AASHO Test Road is given.

2212. Subsurface Exploration in Permafrost Areas, by James R. Cass. (SM) Soil sampling techniques used in two subsurface investigation programs undertaken in the Arctic are described and compared.

2213. Construction Pore Pressures in an Earth Dam, by C.Y. Li. (SM) This paper presents the experience on construction pore pressures in a rolled earth dam and proposes a new method for predicting these pressures.

2214. Rate of Constructing Embankments on Soft Foundation Soils, by Herbert L. Lobdell. (SM) Procedures for predicting and controlling the rate of construction of embankments on soft weak foundation soils are presented.

2215. Major Power Station Foundation In Broken Limestone, by W. F. Swiger and H. M. Estes. (SM) Subsurface pinnacles of limestone surrounded by rubble in clay of varying consistency require detailed examination at each

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building column and equipment foundation to establish an economical type of design for each foundation for a steam power plant.

2216. Structure and Strength Characteristics of Compacted Clays, by H. B. Seed and C. K. Chan. (SM) The influence of soil structure on shrinkage, swelling, swell-pressures, stress-deformation characteristics, undrained strength, pore-water pressures and effective strength characteristics is described.

2217. Design of Underseepage Control Measures For Dams and Levees, by W. J. Turnbull and C. I. Mansur. (SM) Methods of controlling seepage and excessive hydrostatic pressures beneath dams and levees founded on deep strata of pervious sands are presented in this paper.

2218. Matrix Solution of Beams With Variable Moments Of Inertia, by Ming L. Pei. (ST) Using finite differences and matrix algebra, new formulas are developed which are explicit in the desired quantities and are especially suitable for use in digital computer programs.

2219. Reinforced Concrete Folded Plate Construction, by Charles S. Whitney, Boyd G. Anderson and Harold Birnbaum. (ST) This paper presents design methods and discusses experience with the construction of reinforced concrete folded plate thin shells for the roofs and floors of hangars, auditoriums, warehouses and other buildings.

2220. Behavior Of Structures During Earthquakes, by G. W. Housner. (EM) The behavior of structures during earthquakes is described by response spectrum curves which show the effect of size and distance of earthquake and period and damping of structure.

2221. Laterally Deflected Columns, by John Sherman. (ST) This paper considers the case of a column of which the unbent axis is rotated about one end due to the deflection of the other end, a condition which occurs in portals and bents when subjected to lateral loading.

2222. Theory and Test Results On The Fatigue Of Metals, by F. Stuessi. (ST) This paper presents an empirical fatigue relationship between the mean stress and the alternating stress of a cycle; five material characteristics; and the resulting number of cycles to failure.

2223. Bending Moments on Shell Boundaries, by H. H. Bleich and M. G. Salvadori. (ST) This paper is concerned with an estimate of edge effects and their penetration for the case of hyperbolic paraboloids supported on straight generatrices.

2224. Hydraulic Characteristics Of Gate Slots, by J. W. Ball. (HY) Flow turbulence within gate slots, and cavitation damage just downstream from gate slots, occur when wheel (or roller) gates and slide gates are operated at small openings under heads in excess of about 35 feet.

2225. An Analysis Of A Simple Surge Tank, by Frank U. Druml. (HY) This article presents a method for eliminating trials in the arithmetic-step analysis of accelerated flow in a conduit served by a surge tank.

2226. Design, Operation and Maintenance Of Intakes, Racks And Booms: Progress Report Of The Committee On Operation And Maintenance Of Hydrolectric Generating Stations Of The Power Division. (PO) This report compiles certain available data regarding intakes, racks and booms and considers the design philosophy pertaining to them.

2227. Design and Selection of Hyperbolic Cooling Towers, by R. F. Rish and T. F. Steel. (PO) The structural design of hyperbolic cooling towers is examined with particular reference to wind stresses in the shell.

2228. American Power Plant Cooling Towers, by J. A. Scarola. (PO) This paper reviews the historical development of American power plant cooling towers and the civil engineering aspects of the presently accepted mechanical draft towers.

2229. The Design Of Folded Plates, by Eliahu Traum. (ST) Various design theories of folded plate structures are critcially reviewed; the advantages and generality of the Method of Particular Loadings are stressed.

2230. Commentary On Plastic Design In Steel: Additional Design Considerations—I Progress Report Number 3 Of The Joint WRC-ASCE Committee On Plasticity Related To Design, by Lynn S. Beedle. (EM) This paper, third in a series of reports on plastic design, considers shear force and local buckling of flanges and webs.

2231. Commentary On Plastic Design In Steel: Additional Design Considerations—II Progress Report Number 4 of the Joint WRC-ASCE Committee on Plasticity Related To Design, by Lynn S. Beedle. (EM) This fourth paper in the series on plastic design deals with the problem of lateral buckling of beams and considers variable repeated loading.

2232. Discussion of Proceedings Paper 1658, 1892, 2102. (AT) David Williams closure to 1658. J. M. Merzweiler and C. A. Anderson on 1892. William C. Borland closure to 2102.

2233. Discussion of Proceedings Paper 1577, 1908. (PL) L M. Haupt closure to 1577. Arthur L. Collins on 1908.

2234. Discussion of Proceedings Paper 1581, 1693, 1897, 1990. (EM) G. Haaijer and B. Thurlimann closure to 1581. Frank L. Dimaggio closure to 1693. Gideon P. R. Von Willich closure to 1897. George Winter closure to 1990.

2235. Discussion of Proceedings Paper 1808, 1859, 1996, 2057. (HY) Franklin F. Snyder closure to 1808. D. Lee Harris closure to 1859. P. Danel and G. Ransford, Rufus Oldenburger, Ignacy Swiecicki, R. A. Sutherland, Francis E. Swain, Evangelisti and B. Poggi on 1996. John C. Geyer on 2057.

2236. Discussion of Proceedings Paper 1729, 1824, 1863, 1999, 2001. (SM) H. L. Su closure to 1729. Otto H. Meyer closure to 1824. Andrew M. Braswell Jr. closure to 1863. J. Amorocho on 1999. A. A. Eremin on 2001.

2237. Discussion of Proceedings Paper 1694, 1816, 1820, 1854, 1865, 1909, 1970, 2004, 2037. (ST) J. G. MacGregor and C. P. Seiss corrections to discussion of 1694. Panagiotis D. Moliotis closure to 1816. D. G. Fertis and E. C. Zobel closure to 1820. Charles P. C. Tung closure to 1854. Kuang-Han Chu and Algis Pabarcius closure to 1865. Sidney A. Guralnick closure to 1909. W. R. Penman and E. F. Ball on 1970. A. A. Eremin on 2004. O. A. Glogau, M. L. Pei, Michael Jordan on 2037.

2238. Discussion of Proceedings Paper 1536, 1671, 1733, 1738, 1946, 1947, 2061. (PO) G. R. Scott, J. L. Sherard on 1556. F. L. Lawton on 1671. H. E. Lloyd, O. I. Moore, and W. F. Getts on 1733. Robert J. Pope closure to 1738. G. Dugan Johnson on 1946. W. S. McIlquhan, G. Dugan Johnson on 1947. Adolph A. Meyer on 2061.

2239. Alpha-Gamma "Hot" Cells For Entry By Personnel, by John M. Ruddy. (ST) The basic engineering definitions and the effect of the philosophy of maximum set-up and maintenance directly by people on design criteria are presented for this type of "hot" cell.

2240. Non-Steel Cylinder Prestressed Concrete Pipes, by S. R. Hubbard. (PL) Design criteria for prestressed concrete pipes manufactured without a steel cylinder membrane are presented.

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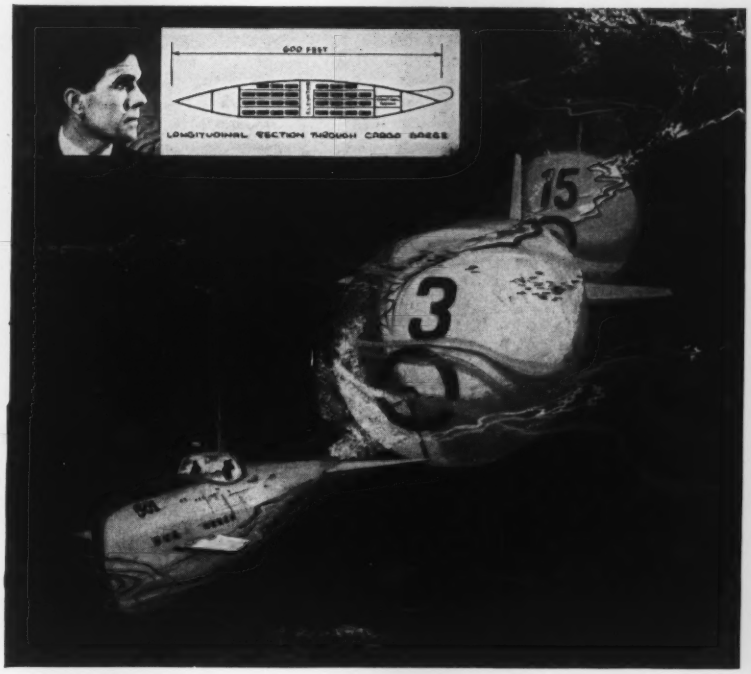

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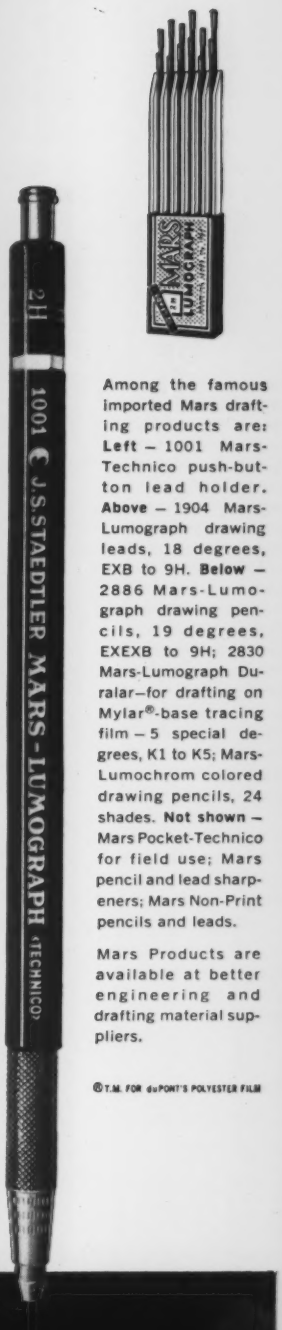
The tug, powered by nuclear reaction, tows a string of cargo vessels, taking advantage of ocean currents and sub-polar routes – free from delays due to weather or tides.

Power supply is adequate for years and tug can remain submerged indefinitely. It can transport cargo to and from many ports without surfacing, since based-in-port auxiliary submarine vessels uncouple the cargo carriers from tug and lead them into underwater pens. There cargo, stored in containers, is transferred by elevators and conveyors to trucks which are then sped by nuclear powered mono-rail to principal distribution points.

This nuclear-age concept of shipping is one more example of the contributions that today's designers are making. To help them translate their pace-setting ideas from concept to reality, they require the best of drafting tools.

In pencils that means MARS, long the standard of professionals.



Among the famous imported Mars drafting products are: **Left** – 1001 Mars-Technico push-button lead holder. **Above** – 1904 Mars-Lumograph drawing leads, 18 degrees, EXB to 9H. **Below** – 2886 Mars-Lumograph drawing pencils, 19 degrees, EXEXB to 9H; 2830 Mars-Lumograph Duralar–for drafting on Mylar®-base tracing film – 5 special degrees, K1 to K5; Mars-Lumochrom colored drawing pencils, 24 shades. **Not shown** – Mars Pocket-Technico for field use; Mars pencil and lead sharpeners; Mars Non-Print pencils and leads.

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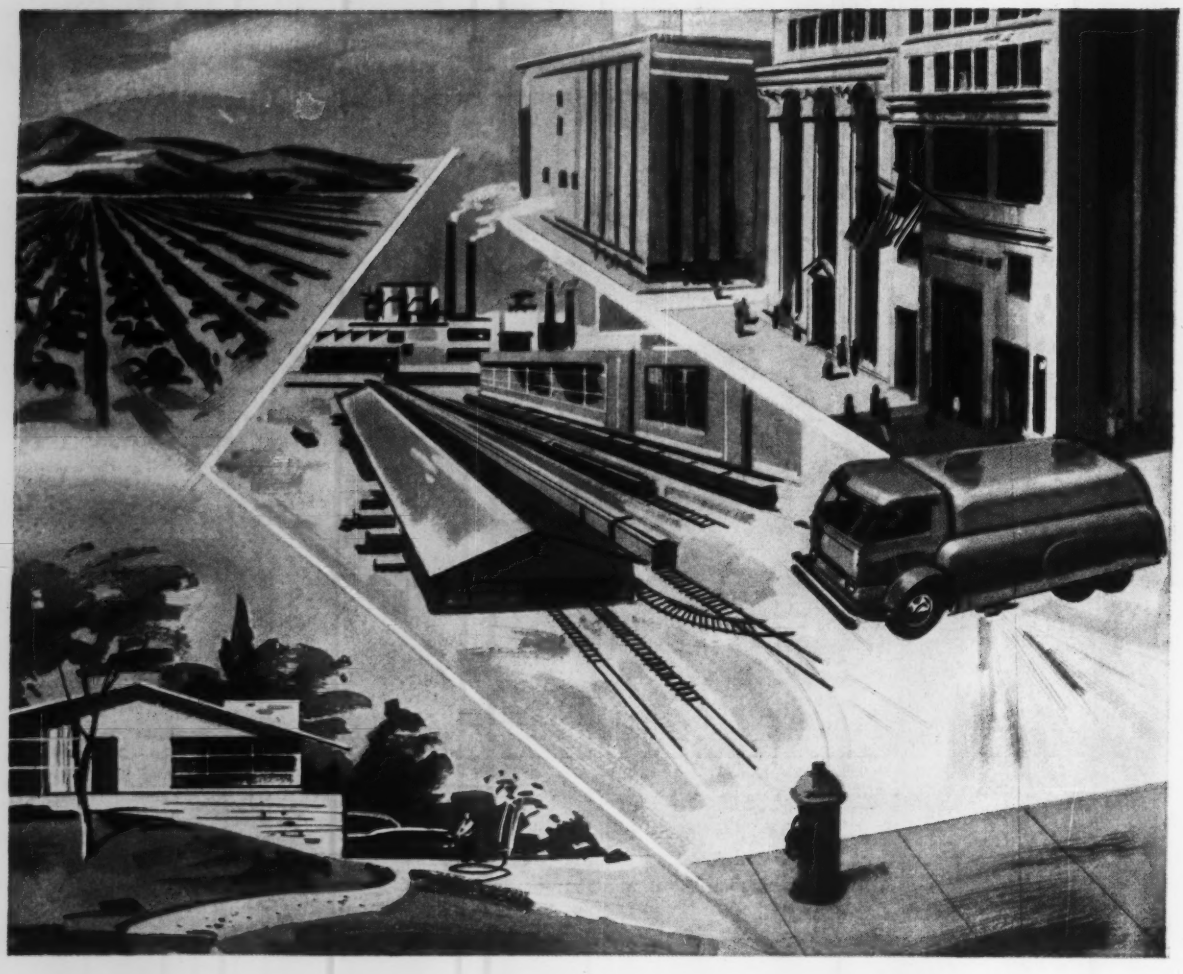

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